1. True or False? A typical chromosome can contain several hundred to several thousand genes, arranged in linear order along the DNA molecule present in the chromosome. **True**

2. True or False? The sequence of nucleotides in the human genome is 90.9% identical from one person to the next. **False (it's 99.9% identical)**

3. True or False? Renaturation is the separation of DNA strands. **False**

4. True or false? DNA polymorphisms are rare in natural populations of most organisms. **False**

5. True of false? Most genes are present in pairs in the nonreproductive cells of most animals and higher plants. **True**

6. Which of the following is false regarding the denaturation of DNA?
   A. DNA can be denatured with high heat.
   B. DNA can be denatured by high pH.
   C. denaturation of DNA can be detected by measuring the UV absorbency at 260 nm.
   D. denaturation disrupts the hydrogen bonds holding the strands together.
   E. DNA can be denatured by low salt conditions. **✓**

7. Which of the following is false regarding $T_m$?
   A. The $T_m$ represents the midpoint of the narrow temperature range at which DNA denatures.
   B. The $T_m$ increases with G + C content.
   C. The $T_m$ decreases with G + C content. **✓**
   D. The $T_m$ decreases with the A + T content.
   E. $T_m$ can be determined by monitoring the change in UV absorbency at 260 nm.

8. DNA fragments migrate in an electric field because DNA molecules
   A. are negatively charged. **✓**
   B. are positively charged.
   C. are neutral in charge.
   D. are double stranded.
   E. contain numerous covalent bonds.

9. Endonucleases
   A. remove amino acids from the carboxyl end of a polypeptide chain.
   B. connect two DNA fragments together.
   C. remove terminal nucleotides from the 3'-end of a polynucleotide chain.
   D. connect two oligopeptides together.
   E. break internal phosphodiester bonds in a single- or double-stranded nucleic acid molecule. **✓**

10. Which of the following statements about PCR is false?
A. PCR stands for polymerase chain reaction.
B. PCR uses short synthetic oligonucleotide primers.
C. PCR uses a DNA polymerase to synthesize DNA.
D. PCR can be used to obtain large quantities of a particular DNA sequence.
E. PCR does not require knowledge of the DNA sequences at the ends of the region to be amplified.

12. Which chemical group is at the 5' end of a single polynucleotide strand?
A. hydroxyl group  
B. phosphate group  ✓
C. diester group
D. purine base
E. nitrogen group

13. Which chemical group is at the 3' end of a single polynucleotide strand?
A. phosphate group
B. hydroxyl group  ✓
C. purine base
D. nitrogen group
E. methyl group

14. The purine bases are
A. thymine and cytosine.
B. thymine and guanine.  ✓
C. adenine and guanine. ✓
D. cytosine and adenine.
E. cytosine and guanine.

15. The pyrimidine bases are
A. thymine and cytosine. ✓
B. thymine and guanine. ✓
C. adenine and guanine.
D. cytosine and adenine.
E. cytosine and guanine.

16. What is the base sequence of a DNA strand that is complementary to 5'- ATCGGATTC - 3' sequence?
A. 5'- ATCGGATTC - 3'
B. 5'- CTAGGCTA - 3'
C. 5'- GAATCGAT - 3' ✓
D. 5'- TAGCCTAAG - 3'

17. If guanine makes up 23% of the nucleotides in a sample of DNA, then thymine would make up what percentage of the bases?
A. 22%
B. 30%
C. 40%
D. 27%
E. 15%

18. Which of the following is not true regarding the structure of DNA?

A. Each chain makes one complete turn every 34 angstroms.
B. Two strands are antiparallel.
C. Ionic bonds are the main force holding the strands together. ✓
D. The purine adenine base pairs with the pyrimidine thymine.
E. The paired bases are parallel to one another and perpendicular to the long axis of the helix.

19. A palindrome is

A. a sequence that reads differently when read from either direction.
B. the type of sequence recognized by most restriction enzymes.
C. a sequence that is the same when read from either direction.
D. a sequence that is used for DNA synthesis.
E. both B and C ✓

20. Which of the following sequences are palindromes?

A. 5'‐ CCAG - 3'
B. 5'‐ CCCC - 3'
C. 5'‐ CCAGG - 3'
D. 5'‐ CCATGG - 3' ✓
E. 5'‐ ACCGGA - 3'

21. What kind of ends are produced by the restriction enzyme CfoI, which recognizes the sequence 5'GCG↓C - 3' and cleaves each strand of DNA helix at the site represented by the downward arrow?

A. Blunt ends
B. 5' overhang
C. 3' overhang ✓
D. none of the above

22. Which of the following is a characteristic of restriction enzymes?

A. most restriction enzymes recognize a single site.
B. the restriction site is recognized regardless of the source of the DNA.
C. the number of times a piece of DNA is cut is determined by the number of times the restriction site is present in the DNA.
D. most restriction sites are palindromes.
E. A, B, C, and D ✓
F. A and C
G. B and D
23. 5'-ACG___-3' is half of a palindromic restriction site. What is the complete sequence?

A. 5'-ACGAGC-3'
B. 5'-ACGCGT-3' ✓
C. 5'-ACGGCA-3'
D. 5'-ACGTGC-3'

24. In a random sequence consisting of equal proportions of all four nucleotides, what is the average distance between consecutive occurrences of the restriction sites for the \( Hinf I 5'\downarrow G\downarrow A N T C \downarrow 3' \), where N stands for any nucleotide and the downward arrow represents the cleavage site?

A. 64 bp
B. 128 bp ✓
C. 256 bp ✓
D. 1024 bp

25. In a random sequence consisting of equal proportions of all four nucleotides, what is the probability that a particular short sequence of nucleotides matches a restriction site for a restriction enzyme with a 4-base cleavage site?

A. 0.4
B. 0.25
C. 0.5
D. \((0.4)^4\)
E. \((0.25)^4\) ✓
F. \((0.5)^4\)

28. The physical or biochemical expression of the genotype is called the ________.

A. phenotype ✓
B. homozygous allele
C. heterozygous allele
D. transcription
E. single-nucleotide polymorphisms

29. A ___________ is defined as any difference in DNA, no matter how it is detected, whose pattern of transmission from generation to generation can be tracked.

A. mutation
B. genetic marker ✓
C. genetic drift
D. consensus sequence

30. The detection of DNA markers usually requires that __________ be fragmented into pieces of manageable size that can be manipulated in laboratory experiments.
A. ribosomes  
B. mRNA  
C. genomic DNA ✓  
D. mitochondrial DNA

31. The presence of a **primer** with a free 3'-OH group is essential for DNA polymerase to synthesize DNA since no known DNA polymerase is able to initiate chains.

32. A **restriction enzyme** is a nuclease that recognizes a short nucleotide sequence in a DNA molecule and cleaves the molecule at that site.

33. The technique used to separate molecules on the basis of their different rates of movement in an electric field is known as **electrophoresis**.

34. Synthesis of DNA is catalyzed by an enzyme called **DNA polymerase** and synthesis of RNA is catalyzed by an enzyme known as **RNA polymerase**.

35. The thymine found in DNA is replaced in RNA by the closely related pyrimidine **uracil**.

36. According to Chargaff’s rules, the amount of guanine in double-stranded DNA molecule equals that of **cytosine**, and the amount of thymine is the same as that of **adenine**.

37. DNA strands are said to be **antiparallel** because the phosphate linkages in the backbones run in opposite directions.

39. The alternative forms of a gene are called **alleles** of the gene.

40. The initial approach to the identification of a disease gene is to find DNA **markers** that are genetically linked with the disease gene in order to determine its chromosomal location, a procedure known as **mapping**.

41. Restriction enzymes that have symmetrical cleavage sites yield DNA fragments that have **blunt** ends.

42. The method for selective **amplification** of a DNA fragment is called the polymerase chain reaction.

43. A **Single Nucleotide Polymorphism**, or **SNP** is present at a particular nucleotide site if the DNA molecules in the population often differ in the identity of the nucleotide pair that occupies the site.

44. Because of their high degree of variation among people, STRs are widely used in **DNA fingerprinting** to establish an individual’s identity for use in criminal investigation and parentage determinations.

45. The utility of DNA **markers** in locating and identifying disease genes results from genetic linkage, which means the tendency for genes that are close together in a chromosome to be inherited together.