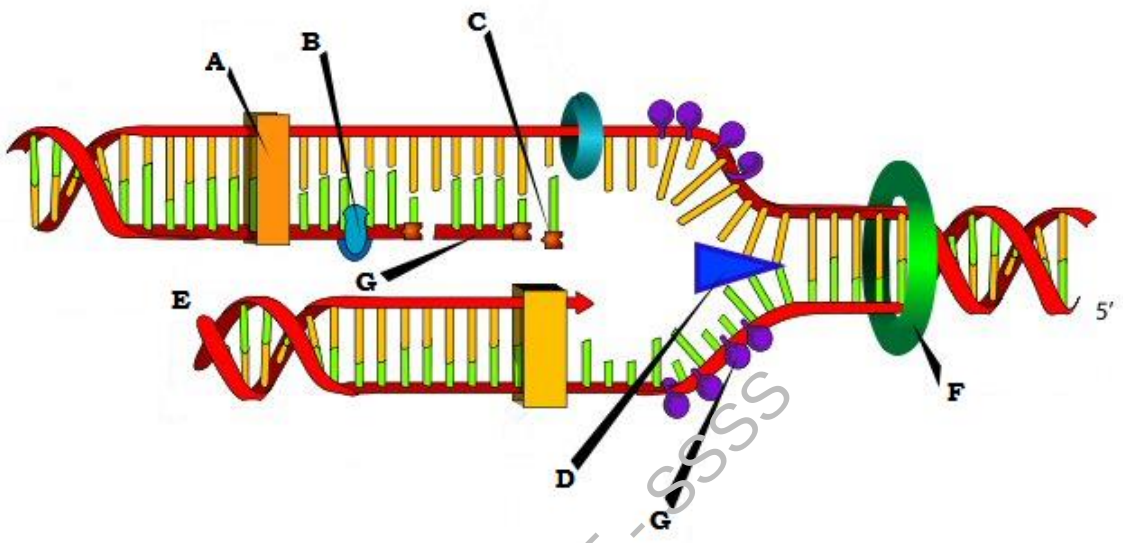
Name: _____

Score: _____ / 119

Use the diagram to answer questions 1-6.



1. What is the polarity of the DNA strand at site E? [1pt] _____
2. What is the name and purpose of enzyme D? [2pt] _____
   _____
   _____
3. The structure labelled G is an Okazaki fragment. Is the upper strand the leading strand or the lagging strand? [2pt] _____
4. What kind of pentose sugar is present in the nucleotide labelled C? [4pt] _____
5. What is enzyme F? [2pt] _____
6. What is the function of the protein labelled G? [4pt] _____
   _____

_____ / 15

Use the result of an electrophoresis assay given to answer the following two questions.

7. What method of DNA sequencing was used to obtain this result? [2pt]
   A. Ion Torrent sequencing
   B. Sequencing by ligation
   C. Chain termination/Sanger sequencing

8. What DNA sequence can be determined for the coding strand (include polarity)? [4pt]
   _____

9. What are the three steps of a PCR? [3pt] _____
   _____

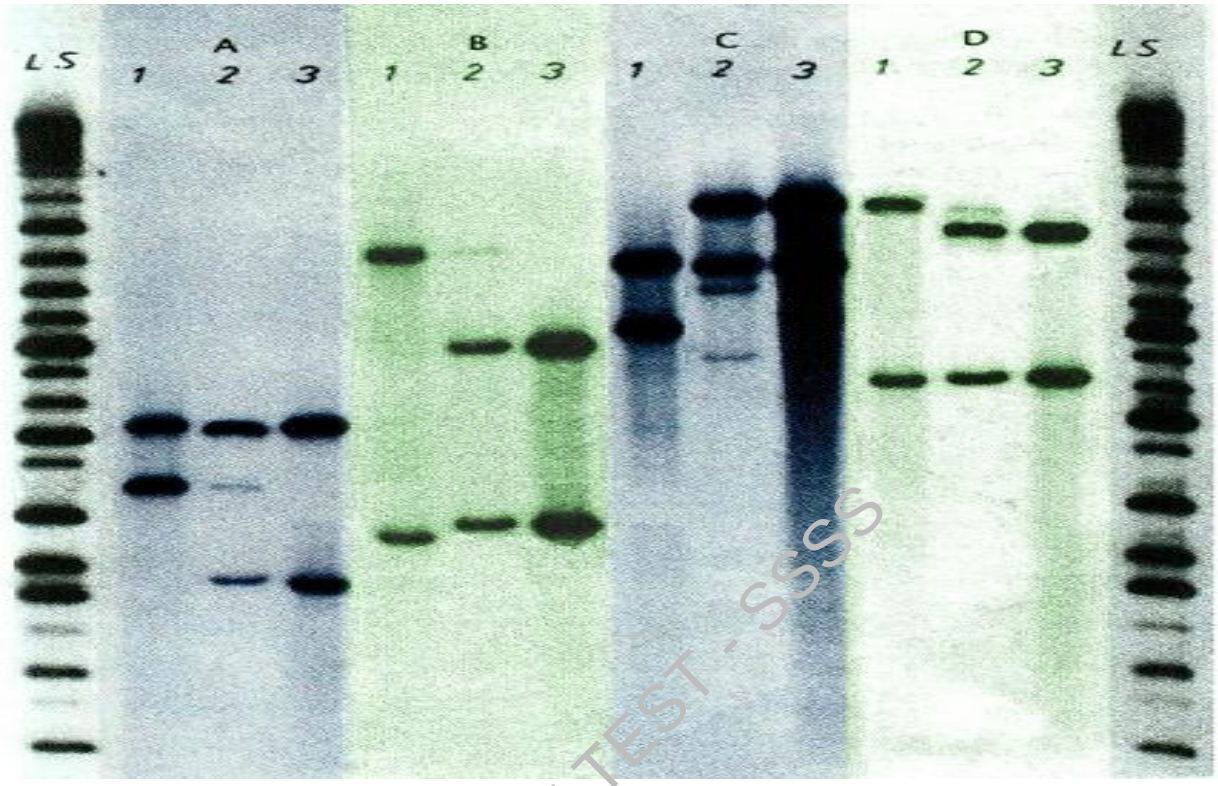
10. What temperatures, in Celsius, correspond to each step of PCR? [3pt] _____
    _____

11. Which of the following scientists were involved in the discovery of DNA's semiconservative replication? [2pt]
    A. Alfred Hershey
    B. Rosalind Franklin
    C. Matthew Meselson
    D. Frederick Sanger

12. Ultraviolet radiation can act as a mutagen in which of the following ways? [2pt]
    A. It creates thymine dimers.
    B. It synthesized benzo[a]pyrene.
    C. It creates adenine dimers.
    D. None of the above.

_____ / 16

The DNA fingerprints in the image below are used for RFLP analysis. Use the image to answer questions 13 and 14.



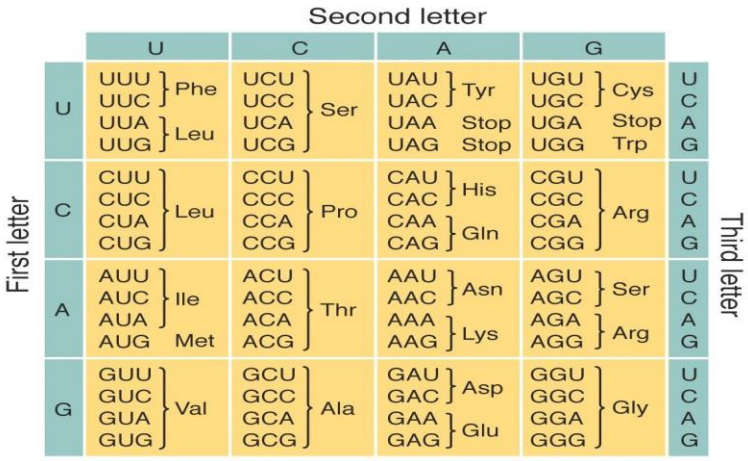
13. The lanes in group A are used as a paternity test. If lane 3 is the DNA from a child, is it possible for the individuals for lanes 1 and 2 to be the parents? [2pt] _____

14. In group B, lanes 2 and 3 are identical. Is there more or less DNA in lane 1 relative to the other two lanes? [2pt] _____

15. What does RFLP stand for? [1pt] _____

_____ / 5

Use the information below to answer questions 16-20.



First letter	Second letter: U	Second letter: C	Second letter: A	Second letter: G	Third letter
U	UUU, UUC: Phe; UUA, UUG: Leu	UCU, UCC, UCA, UCG: Ser	UAU, UAC: Tyr; UAA: Stop; UAG: Stop	UGU, UGC: Cys; UGA: Stop; UGG: Trp	U C A G
C	CUU, CUC, CUA, CUG: Leu	CCU, CCC, CCA, CCG: Pro	CAU, CAC: His; CAA, CAG: Gln	CGU, CGC, CGA, CGG: Arg	U C A G
A	AUU, AUC, AUA: Ile; AUG: Met	ACU, ACC, ACA, ACG: Thr	AAU, AAC: Asn; AAA, AAG: Lys	AGU, AGC: Ser; AGA, AGG: Arg	U C A G
G	GUU, GUC, GUA, GUG: Val	GCU, GCC, GCA, GCG: Ala	GAU, GAC: Asp; GAA, GAG: Glu	GGU, GGC, GGA, GGG: Gly	U C A G

In the alien flower species *Pretty pretty*, one protein is responsible for attaching tiny, brittle fibers to the plant's stem. The amino end of the protein attaches to cell walls of the outermost layer of cells on the stem, and the carboxyl end attaches to the fiber. The DNA sequence for the protein is:

3'-TACCAGCGCGTTGATGGATCAATT-5'

If an adenine nucleotide replaced a guanine such that the sequence was changed to:

3' - TACCAGCGCATTGATGGATCAATT - 5'

then:

16. What is the amino acid sequence of the normal protein? [2pt] _____
_____

17. What is the amino acid sequence of the mutant protein? [2pt] _____
_____

18. How would the protein be affected by the mutation? [2pt]
_____

19. What kind of mutation is this? [3pt] _____

20. How would this affect protein function? [3pt] _____
_____
_____

21. In the Lac operon, which molecule acts as the inducer? [2pt] _____

22. In the Lac operon, as glucose levels rise, how is lactose metabolism affected? [3pt] _____
_____

23. In the Trp operon, which molecule acts as the corepressor? [2pt] _____

_____ / 19

24. Four nucleic acid samples are analyzed to determine the percentages of the nucleotides they contain. Survey the data in the table below and determine which samples are DNA and which are RNA, and specify whether each sample is double-stranded or single-stranded. Justify each answer. (Source: *Genetic Analysis* by Mark F. Sanders) [8pt]

	A	G	T	U	C
Sample 1	22%	28%	22%	0	28%
Sample 2	30%	30%	0	20%	20%
Sample 3	18%	32%	0	18%	32%
Sample 4	29%	29%	21%	0	21%

_____
_____
_____
_____
_____
_____

Use the DNA sequence to answer questions 24-26.

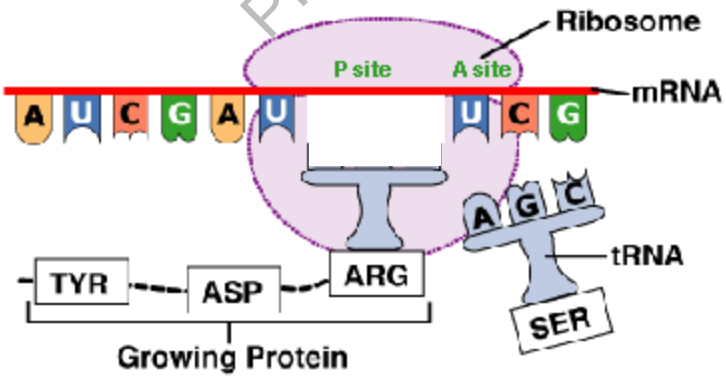
5' - ATGCCAGTCACTGACTCC - 3'
3' - TACGGTCAGTGACTGAAC - 5'

25. How many phosphodiester bonds are needed for this segment of DNA? [1pt] _____

26. How many hydrogen bonds are there in this segment? [2pt] _____

27. If the lower strand is used to create a polypeptide, how many peptide bonds will there be in the resulting polypeptide fragment? [2pt] _____

Use the figure to answer the following two questions.



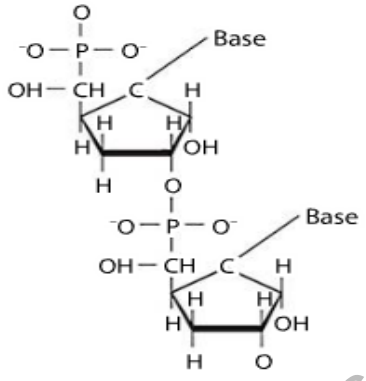
28. What process is illustrated in the figure? [1pt] _____

29. From 5' to 3', what is the sequence of the blocked portion mRNA? [3pt] _____

_____ / 17

30. What enzyme binds amino acids to specific tRNA molecules? [2pt] _____
_____

Use the following information to answer question 31: You are participating in a study group preparing for an upcoming biology exam. The group decides that each person should draw the structure of two DNA nucleotides joined in a single strand. The figures are drawn and exchanged for correction. You receive the drawing below to correct. (Source: Genetic Analysis *by Mark F. Sanders)*



31. Identify and correct five things that are wrong in the depiction of the nucleotides. [10pt] _____
_____
_____
_____
_____
_____

Match the laboratory procedures in questions 32-37 with their descriptions. [1pt each]

A. A type of hybridization that uses DNA or RNA probes to localize a specific DNA or RNA strand in tissues (e.g. *Drosophila* embryos).
B. A technique used to study gene expression by detection of RNA.
C. A technique used to study DNA-binding proteins and their ability to bind to specific nucleotide sequences.
D. A technique used to detect specific DNA sequences within DNA samples.
E. A collection of microscopic DNA spots attached to a solid surface
F. An analytical technique used to detect specific proteins in a given tissue sample.

32. Southern blot: _____

33. Northern blot: _____

34. Western blot: _____

35. Southwestern blot: _____

36. *in situ* hybridization: _____

_____ / 17

37. DNA microarray: _____

38. Describe the function of miRNA. [4pt] _____
_____
_____
_____

39. Which of the following enzymes synthesizes cDNA from a single strand of RNA? [2pt]
    A. reverse transcriptase
    B. DNA ligase
    C. aminoacyl tRNA synthetase
    D. nucleoprotein kinase III

40. For a proteasome to degrade a protein, what molecule must first bind to the protein? [2pt]

Questions 41-45 are true/false. [1pt]

41. miRNA is used to control gene expression. _____

42. In eukaryotes, after transcription, mRNA goes directly to ribosomes for translation. _____

43. If a researcher introduced radioactive cytosine into a cell culture, after one round of replication, all bacteria would be radioactive. _____

44. In prokaryotes, mitochondrial DNA is inherited from the father. _____

45. Eukaryotes control levels of gene expression through histone acetylation and DNA methylation. _____

46. A mutation changes a single base in a codon so that the amino acid it codes for changes from Asp to Gly. What single nucleotide changes could cause this? There are two; write both the starting and the altered codons (Source: *Genetic Analysis* by Mark F. Sanders). [4pt] _____
_____
_____

47. What technique did James Watson and Francis Crick (aided by Rosalind Franklin) use to determine the double helix structure of DNA? [2pt]
    A. *in situ* hybridization
    B. X-ray crystallography
    C. phosphodiester-enzyme analysis

48. The negative charge on which part of a DNA nucleotide causes DNA to move towards the positive node during an electrophoresis assay? [2pt] _____

49. Which of the following is NOT contained within the spliceosomes that cut out introns during post-transcriptional mRNA processing? [3pt]
    A. snRNA
    B. snRNP
    C. miRNA
    D. ribozymes

50. What does snRNP stand for? [2pt] _____

51. Which of the following RNA sequences would form the strongest stem-loop structure? [2pt]
    A. 5' – AGGCUAUAGGGAGCCU – 3'
    B. 5' – AGCGUAUAGGGAGCCU – 3'
    C. 5' – AGGCUAUAGGGAAAAA – 3'
    D. 5' – AGGCTATAGGGAGCCT – 3'