DNA and its Functions

Part A - Multiple Choice Questions

1. C
2. A
3. D
4. B
5. C
6. B
7. C
8. A
9. A
10. B
11. D
12. D
13. C
14. B
15. B
16. D
17. A
18. B
19. B
20. B
21. B
22. A
23. A
24. A
25. B
26. B
27. C
28. C
29. C
30. B
31. A
32. C
33. A
34. C
35. D
36. D
37. B
38. C
39. A
40. A
41. D
42. B
43. A

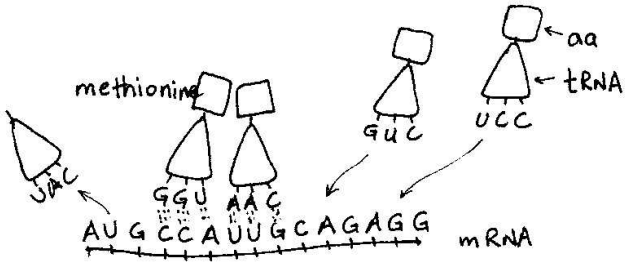
Part B – Written Answers

Note: The answers provided here are correct, but they may NOT be the only possible answers.

1. The DNA segment contains 110 nucleotides. There are 32 Guanine nucleotides, and therefore also 32 Cytosine nucleotides (DNA is double-stranded and these bond together.) As well, there are 23 Adenine nucleotides and 23 Thymine nucleotides. All adds up to 110.

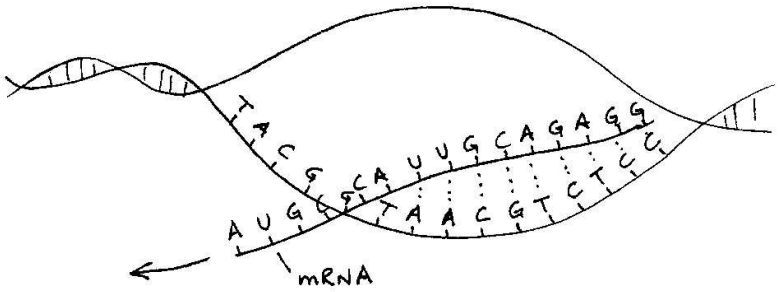
2. a. Base deletion occurs when an intended nucleotide is left out of the sequence that is being formed. The new DNA strand that is produced is, therefore, one nucleotide short. This has a disastrous effect on the protein that would be coded for by this strand because the triplet codons that would be formed from it would (most likely) be incorrect from the point of the deletion on to the end of the strand.
   b. Base addition occurs when an additional nucleotide is incorporated into the sequence that is being formed. The new DNA strand that is produced is, therefore, one nucleotide longer than it should be. This has a disastrous effect on the protein that would be coded for by this strand because the triplet codons that would be formed from it would (most likely) be incorrect from the point of the addition on to the end of the strand.
   c. Base substitution occurs when the incorrect nucleotide is incorporated into the strand that is being produced. This very often means that the mRNA strand that this segment of DNA has a single codon that codes for an incorrect amino acid. If it does, the resulting protein will have an error in it and the molecule will not function as it is intended. However, the Genetic Code is degenerative, meaning that some substitutions, particularly when they are in the third position, do not have any bearing on the protein that is made. In these cases, the protein will be correct and the mutation will not be manifested phenotypically.

3. a and b.



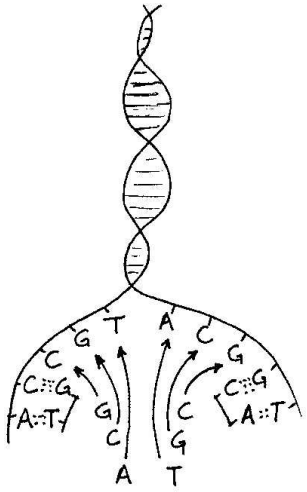
   c. The product of translation is protein. The proteins can be considered in two groups depending on the location of the ribosome involved. If the ribosome is free in the cytoplasm or part of a polysome, then the protein will be used in the cytoplasm. If the protein is embedded in RER, then it will be put into a vesicle and may eventually be secreted like a protein hormone or digestive enzyme or something (secretory pathway) or be put into a lysosome and a hydrolytic enzyme and used for intracellular digestion, for example.

4. a, b, and c.



   d. The product of transcription is mRNA. The process occurs in the nucleus, and the mRNA once it is made leaves the nucleus through a nuclear pore and travels to a ribosome where it is involved in translation.

5. a and b.



   c. Replication is the process whereby DNA molecules make replicas of themselves. The resulting molecules are identical because each one is formed from one of the parent strands by complementary base pairing.

6. Mutations have their greatest impact if they occur during replication. In every case, a mutation may produce an incorrect protein (eventually), but if it occurs during translation or transcription, only one molecule of protein is produced incorrectly, and the next time that gene is used, the process may occur properly. In the case of mutations during replication, these affect the DNA molecule itself and every time its genes are used, the effect of the mutation will show up in the proteins that are produced.

7. a. Recombinant DNA is the name given to a segment of DNA that is produced by combining DNA from two sources.
   b. There are many human advantages to producing recombinant DNA, such as the mass production of much needed proteins like insulin. A disadvantage is the potential for misuse of the technology and the uncertainty that something harmful may be produced.

8. The biological advantage of replication is that DNA can make copies of itself for cell division purposes. The production of protein is significant because it is though the activities of proteins like enzymes that cells function. Mutations are advantageous in terms of species survival. These chromosomal variations provide raw material for Natural Selection.

9. The start codon is the initiating base sequence used in the production of any protein. The start codon, (AUG), codes for methionine. Stop codons signal the termination of translation and the end of the protein. There are no amino acids coded for by the stop codons.