

DNA REPLICATION AND PROTEIN SYNTHESIS ANSWERS

1. DNA is made of nucleotides. Each nucleotide consists of a nitrogen base, a phosphate group, and a deoxyribose sugar.
2. DNA will replicate itself when the cell is undergoing cell division, that is, new cells are being made from pre-existing cells. Examples of when this will occur are sperm and ova production, and the increase in the number of cells as the organism grows.
3. Adenine on one strand of DNA pairs with Thymine on the other strand. Similarly, Guanine pairs with Cytosine.
4. A nucleotide is made of a nitrogen base, a phosphate group, and a sugar.
5. DNA is a double-stranded helix where each strand spirals around the other. The nitrogen bases in the nucleotides of DNA are adenine and thymine, and guanine and cytosine. The nitrogen bases make up the rungs of the spiralled ladder. The uprights of the spiralled ladder are alternating phosphate groups and deoxyribose sugars. If one strand has a particular nitrogen base (e.g. adenine), then its complementary strand will have the complementary nitrogen base (e.g. thymine).
6. DNA - double stranded, contains adenine thymine cytosine and guanine, found in the nucleus, makes RNA
RNA - single stranded, contains adenine uracil cytosine and guanine, found in both the nucleus and the cytoplasm
7. (a) The complementary strand has CTT CAT GGT on the rungs of the ladder. Remember to sketch the phosphate groups and the sugars on the uprights.
7. (b) The mRNA strand will be the complement of the DNA strand stated in the question, except that mRNA will contain uracil instead of thymine - CUU CAU GGU.
7. (c) The half-rungs will contain the nitrogen bases of Q7(b), and the single upright will contain alternating phosphate groups and sugars.
7. (d) The amino acids in sequence will be Leucine - Histidine - Glycine.

8. All 3 types of RNA are made from DNA in the nucleus, and pass through the pores in the nuclear membrane to the cytoplasm. The ribosomal RNA becomes a large part of the ribosomes, the workbenches where proteins are made. The messenger RNA is a long strand containing many 3-nucleotide codons, and the mRNA positions itself across the ribosome. The transfer RNA is also a single strand but is a keyhole shape and contains only one main 3-nucleotide anticodon which codes to attach to a specific amino acid. The tRNA picks up its specific amino acid from the cytoplasm, and transports it to the complementary mRNA at the ribosome. Having attached that amino acid, the tRNA detaches itself and returns to the cytoplasm. The next tRNA then picks up and transports its specific amino acid to the mRNA at the ribosome. This process continues until the whole protein is complete and then is detached.

9. A codon is a 3-nucleotide sequence found on DNA and mRNA, though mRNA is the complement of the DNA coding strand. The anticodon is a 3-nucleotide sequence found on tRNA and is the complement of the mRNA's codon.

10. Refer to Q8.

11. Transcription is the process by which all 3 types of RNA are made from DNA. Translation is the process of assembling a protein from specific amino acids that are coded for by the DNA and RNA.

12. An example of a start codon on the DNA strand is TAC. An example of a stop codon on the DNA strand is ACT.

13. (a) Thymine

13 (b) Uracil

14. The 16 possible 2-nitrogen base combinations are AA, AG, AC, AU, GA, GG, GC, GU, CA, CG, CC, CU, UA, UG, UC, UU.

15. DNA - GGC CAT TCC GTG
mRNA - CCG GUA AGG CAC
tRNA - GGC CAU UCC GUG

16. (a) No. of amino acids = $240\,000 - 140$
= 1714

16. (b) No. of nucleotides = 1714×3
= 5142

16. (c) Approximate molecular weight of mRNA = 5142×186
= 956412

16. (d) No. of codons = $5000 - 3$
= 1667

No. of amino acids = 1667

From Q16 (a), there are about 1714 amino acids in the protein catalase. If this is an average- sized protein, then one DNA molecule would make only one protein.