

# SOLUTIONS

## Unit 6: Nucleic acids and protein synthesis

### 6.1: Structure and replication of DNA

- D**  
DNA polymerase catalyzes the formation of phosphodiester bonds between nucleotides, linking the phosphate group of one nucleotide to the sugar of another, forming the backbone of DNA.
- C**  
Thymine is diagram 2, and cytosine is diagram 3. Both are pyrimidine bases found in DNA.
- A**  
In nucleotides, the nitrogenous base is attached to carbon atom 1 of the pentose (1), the phosphate group is linked to carbon atom 5 (2), and condensation reactions join both the base and the phosphate to the pentose (3). Statement 4 is incorrect because nucleotides are not linked via phosphate-phosphate bonds.
- D**  
In a circular DNA molecule with 2700 base pairs, there are 5400 nucleotides, and each nucleotide is linked by a phosphodiester bond, totaling 5400 bonds in the entire molecule.
- B**  
Purines (A, G) are larger than pyrimidines (C, T, U) (1). Complementary base pairing happens during translation (2), and uracil pairs with adenine by forming two hydrogen bonds (4).
- C**  
Phosphodiester bonds in the DNA backbone are formed between nucleotides by DNA ligase, ensuring the stability of the DNA strand.
- C**  
During DNA replication, the leading strand (S1) is synthesized continuously in the 5' to 3' direction, while the lagging strand (S2) is synthesized discontinuously in short fragments. Diagram C correctly shows this with S1 proceeding smoothly and S2 with gaps, representing Okazaki fragments.
- B**  
After one generation in  $^{14}\text{N}$ , all DNA is hybrid, containing both  $^{15}\text{N}$  and  $^{14}\text{N}$ . After two generations, 50% of the DNA is hybrid (one strand  $^{15}\text{N}$ , one strand  $^{14}\text{N}$ ), and 50% is purely  $^{14}\text{N}$  due to semi-conservative replication.
- D**  
In DNA, adenine (A) pairs with thymine (T), and cytosine (C) pairs with guanine (G). Option D correctly shows these base pairings and a deoxyribose-phosphate backbone, unlike the other options which show incorrect bases or pairings.
- D**  
The short fragments of DNA (Okazaki fragments) formed during lagging strand replication have sequences complementary to the leading strand and consist of a single polynucleotide strand. DNA also contains more elements than just carbon, hydrogen, oxygen, and nitrogen, like phosphorus.
- D**  
Purines (A and G) make up 40%, so pyrimidines (C and T) make up 60%. When transcribed, T is replaced by U, meaning 60% of the bases in the RNA will be cytosine and uracil.