# DNA Double Helix, Complementary Base Pairs and Antiparallel Strands

IB Biology - A1.2 Nucleic acids | Level: SL core | Suggested time: 45 minutes

| | | |
|---|---|---|
| Assessment pattern<br>Multiple choice<br>Short answer<br>Data response<br>Extended response | Total marks<br>27<br><br>Coverage<br>SL focus with integrated application | Syllabus focus<br>• A1.2.6 DNA as a double helix with two antiparallel strands<br>• Complementary base pairs A-T and C-G<br>• Hydrogen bonding between strands |

## Instructions

- Answer all questions unless your teacher tells you otherwise.
- Show biological reasoning clearly in short-answer, data-response and extended-response items.

## Section A - Multiple choice

Choose the best answer in each case.

1. Which base pairing is correct in DNA? [1]

   A. A with C

   B. A with T

   C. G with T

   D. C with A

2. What holds the two DNA strands together? [1]

   A. Peptide bonds

   B. Hydrogen bonds between complementary bases

   C. Ionic bonds between phosphates

   D. Glycosidic bonds between sugars

3. What is meant by the strands of DNA being antiparallel? [1]

   A. They are made of different sugars.

   B. They run in opposite directions relative to each other.

   C. They contain opposite genes.

   D. They repel each other.

4. In a ladder model of DNA, the sides of the ladder are made of: [1]

   A. Nitrogenous bases only

   B. Sugars only

   C. Alternating sugar and phosphate groups

   D. Proteins and lipids

5. Which statement about complementary base pairs is correct? [1]

A. Any base can pair with any other base.

B. A and T always pair, and C and G always pair.

C. Only purines pair with purines.

D. Only thymine and guanine pair.

## Section B - Short answer

6. Define the term complementary base pairing. [3]

7. Explain why separating the two strands of DNA makes accurate copying possible. [3]

8. Explain one reason why a ladder diagram is useful even though it does not show the full helical shape of DNA. [3]

## Section C - Data response / case study

9. Data response - Base pairing in a DNA fragment [7]

A student counted the bases on one strand of a short double-stranded DNA fragment.

Table 1. Base counts on one strand of DNA

| Base on strand 1 | Count |
|---|---|
| A | 12 |
| T | 8 |
| C | 5 |
| G | 7 |

9(a) State the number of thymine bases expected on strand 2. [2]

9(b) Calculate the total number of cytosine bases in the complete double-stranded fragment. [2]

9(c) Explain how the base-pairing rules help DNA maintain an accurate structure during replication. [3]

## Section D - Extended response

10. Explain how the structure of DNA facilitates accurate replication. [6]

# DNA Double Helix, Complementary Base Pairs and Antiparallel Strands - Answer key and marking guidance

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## General marking guidance

- Award credit for clear biological meaning even if wording differs from the model answer.
- Do not award more than the maximum marks shown for each question.
- For extended responses, reward linked explanation rather than isolated word lists.

## Multiple choice answers

| Q | Answer | Why it is correct |
|---|---|---|
| 1 | B | In DNA, adenine pairs with thymine and cytosine pairs with guanine. |
| 2 | B | Hydrogen bonding links complementary bases on opposite strands. |
| 3 | B | Antiparallel strands are parallel in shape but opposite in direction. |
| 4 | C | The backbone is an alternating sugar-phosphate chain. |
| 5 | B | Complementary base pairing in DNA is fixed as A-T and C-G. |

## Short answer and data response guidance

### 6. Define the term complementary base pairing. [3]

- Specific bases pair only with their matching partner.
- In DNA, adenine pairs with thymine and cytosine pairs with guanine.
- The pairing is based on hydrogen bonding.

Marking guidance: Award up to 3 marks for a complete definition including examples.

### 7. Explain why separating the two strands of DNA makes accurate copying possible. [3]

- Each exposed strand shows its sequence of unmatched bases.
- Free nucleotides can pair by complementarity with these bases.
- This allows each original strand to act as a template for a copy.

Marking guidance: Award 1 mark per linked point, max 3.

### 8. Explain one reason why a ladder diagram is useful even though it does not show the full helical shape of DNA. [3]

- It clearly shows the two strands and the base-pairing pattern.
- It helps identify nucleotides, complementary pairs and antiparallel arrangement more easily.
- It simplifies the structure for learning or analysis without changing the pairing rules.

Marking guidance: Award up to 3 marks for a sensible explanation.

### 9(a). State the number of thymine bases expected on strand 2. [2]

- 12 thymine bases.

Marking guidance: Award 1 mark for the correct value and 1 mark if linked to adenine-thymine pairing.

### 9(b). Calculate the total number of cytosine bases in the complete double-stranded fragment. [2]

- 12 cytosine bases in total.
- There are 5 on strand 1 and 7 on strand 2 because cytosine pairs with guanine.

Marking guidance: Award 2 marks for the correct total with working or explanation.

### 9(c). Explain how the base-pairing rules help DNA maintain an accurate structure during replication. [3]

- Only the correct complementary nucleotides fit by hydrogen bonding.
- This reduces random pairing errors.
- Each original strand guides the sequence of the new strand.

Marking guidance: Award up to 3 marks for a linked explanation.

## Extended response guidance

### 10. Explain how the structure of DNA facilitates accurate replication. [6]

- DNA is double-stranded.
- The strands can separate/unzip.
- Each original strand exposes a sequence of bases.
- Complementary base pairing ensures A pairs with T and C with G.
- Free nucleotides join according to the template sequence.
- Two DNA molecules result, each matching the original sequence.

Marking guidance: Award up to 6 marks for a clear explanation from strand separation to accurate copying.