

Model Answers: Medium

1

The correct answer is **C** because:

- Thymine (T) and cytosine (C) are **pyrimidines** and have **single** ring structures.
- Adenine (A) and guanine (G) are **purines** and have a **double** ring structure.
- In this diagram, pyrimidines are shown as the smaller shapes and purines are shown as the larger shapes.
- Option **C** is incorrect because **adenine is depicted as a pyrimidine** (single ring structure).

2

The correct answer is **B** because:

- There is a total of 19 base pairs per chain
- $19 - 8 - 3 - 4 = 4$
- Therefore, there are **4 nucleotides containing adenine** on strand 2

On strand 1 there would be:

- **4 thymine** that bond with the 4 adenine on strand 2
- **4 guanine** that bond with the 4 cytosine on strand 2
- **3 cytosine** that bond with the 3 guanine on strand 2

3

The correct answer is **B** because:

- The first step in DNA replication is that the cell receives a **signal to divide**
- **Semi-conservative** replication copies the DNA of a cell so that there is two sets of DNA, one for each daughter cell of the division
- The **DNA helix** is then unwound to allow easier access to the **nucleotide bases**
- Once the helix is unwound, **hydrogen bonds** between bases must be broken to allow **DNA polymerase** to bind onto one strand
- When the strands are exposed, DNA polymerase moves from the 5' end to the 3' end of the old strand adding **free nucleotides** to the bases and **hydrogen bonds** form between the nucleotide on the old chain and a complementary free nucleotide
- DNA ligase **covalent bond** then forms between the **phosphate** and the **deoxyribose sugar** of two free nucleotides next to each other and this creates a new chain
- Therefore, one strand of the new DNA molecule is old and one is new (made from free nucleotides) hence, semi-conservative replication

4

The correct answer is **C** because:

- The complementary bases pairs are adenine with thymine and cytosine with guanine
- The ratios of **complementary base** pairs are equal however the percentages found in this data aren't exactly equal – this could be to do with experimental error
 - Because the % thymine is 11, **W = 9%**
 - Because the % guanine is 27, **X = 25%**
 - Because the % cytosine is 41, **Y = 38%**
 - Because the % adenine is 30, **Z = 29%**

These values are **percentages** and therefore each row must **add to 100!**

5

The correct answer is **A** because:

- In every nucleotide there is one **phosphate group**, one **pentose sugar** and one **base**. Therefore there would be an equal ratio of pentose sugars to phosphates (1:1).
- **Thymine** and **adenine** are **complementary bases** and therefore they will appear in equal numbers in a DNA molecule.

6

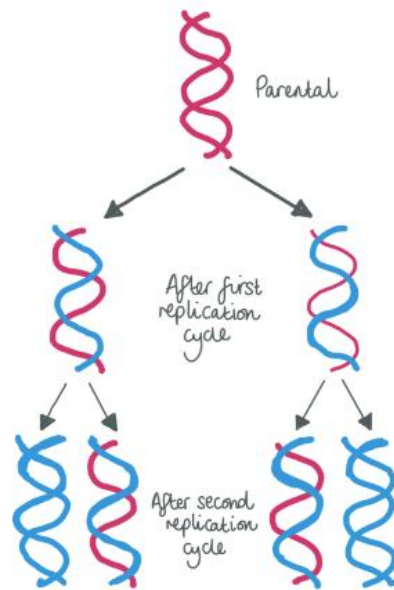
The correct answer is **B** because:

- A strand of DNA consists of **nucleotide monomers** made up of a **phosphate group** (circle), a **deoxyribose sugar** (pentagon) and a **base** (the middle shapes)
- **1** shows the **phosphate-sugar backbone** which does **not** contain any bases or hydrogen bonds
- **2** shows a **single nucleotide** which contains a **base** but **not** any hydrogen bonds
- **3** shows a **base pair** which contains **two** bases and hydrogen bonds, this shows a cytosine-guanine base pair because there are **three** hydrogen bonds
- **4** shows just a **base**

7

The correct answer is **D** because:

- **Bacteria** is grown in **^{15}N medium** for many generations
- This is to ensure that all bacteria in the experiment start with DNA that has **only ^{15}N** nitrogen in its bases
- Bacteria are then moved to **^{14}N medium** and sampled every hour. It is important to sample on this time scale because bacteria **replicate** quickly and when they divide to produce new cells, they will now use ^{14}N to produce the bases for DNA
- DNA is semi-conserved through the replication process. This means that in the first **replication cycle**, the old ^{15}N DNA will unwind and the two strands will separate. ^{14}N containing free nucleotides will be added to complement each original strand and form two new strands
- The result will be two new bacteria, each with **hybrid DNA** – one **strand** of DNA will contain **^{15}N only** (this is the original and conserved DNA made from when bacteria was in ^{15}N medium) and the other new strand will contain ^{14}N only
- In the second division, the hybrid DNA unwinds and the two strands separate and two new **complementary** strands are made. This produces:
 - one DNA molecule that has one ^{15}N strand and one ^{14}N strand
 - Another DNA molecule that consists of two ^{14}N strands.



8

The correct answer is **C** because:

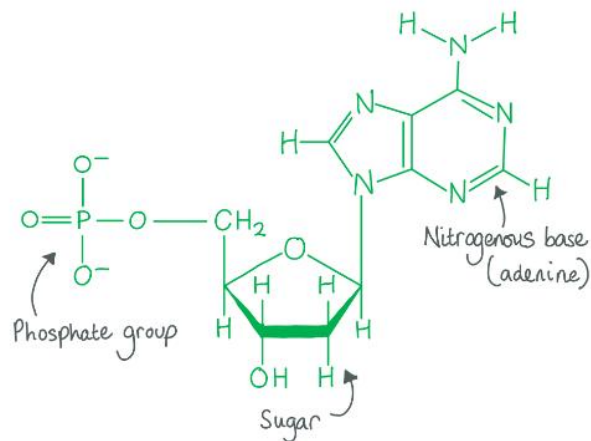
- The circle shapes depict **phosphate groups (Z)**.
- The pentagon shapes depict **ribose sugars (Y)**.
- The different sized shapes depict different bases, **purines** have a **double** ring structure and are shown bigger than **pyrimidines** that are only **single** ringed.\
 - Adenine is already shown so the other purine is **guanine (W)**.
 - **X** has a complementary shape to adenine and is therefore **Uracil**.

9

The correct answer is **D** because:

- A **pyrimidine** is a type of base that has a **single ring** structure.
- The three pyrimidine bases found are:
 - **cytosine**, found in **both** DNA and RNA
 - **uracil**, found in RNA **only**
 - **thymine**, found in DNA **only**

A, B & C are incorrect as adenine and guanine are double ring structures called purines. Adenine and guanine are found in both DNA and RNA.



10

The correct answer is **D** because:

1. In the first base pair: three **hydrogen bonds** form between cytosine (C) and guanine (G) and only two are shown
2. In the first base pair: cytosine (C) is a **pyrimidine**, it had a **1 ring structure**, and guanine (G) is a purine and has a 2 ring structure – therefore C should be shown as a small base and G a big base
3. In the last base pair: cytosine (C) and guanine (G) are complementary however **adenine** (A) is shown to pair with guanine
4. On the whole right strand: the **phosphates** are bound to the wrong side of the **deoxyribose sugars**. Phosphates always bind to the opposite side to the base. The strands should run in antiparallel directions (one goes 3' to 5' and the other 5' to 3')