7.3 Translation

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Course	DP IB Biology
Section	7. Nucleic Acids (HL Only)
Topic	7.3 Translation
Difficulty	Medium

To be used by all students preparing for DP IB Biology HL
Students of other boards may also find this useful

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The correct answer is **D**: at the very start of initiation the small ribosomal subunit binds to the mRNA molecule and a charged initiator tRNA binds (to the small subunit). The ribosomal subunit then moves along the mRNA until it locates the start codon. The large ribosomal subunit then binds to form the ribosomal complex. This triggers the start of the elongation phase of translation.

A, **B** and **C** are incorrect as they refer to the correct stages but in the wrong order.

2

The correct answer is **A** as tRNA helps translate the **codons** of the mRNA molecule into amino acids; tRNA molecules have an anticodon region that is complementary to the codon.

All the other statements are functions of tRNA.

3

The correct answer is **C**: the movement of the ribosome along the mRNA results in the tRNA moving from the **A site** (where it bound **initially**) to the **P site**, this **frees up** the A site for another tRNA.

- **A** is incorrect, as it is in the wrong direction
- **B** is incorrect, as immediately after translocation, the E site will be occupied by tRNA previously occupying the P site; however, the tRNA will be ejected from the ribosome prior to the next translocation
- **D** is incorrect, as the polypeptide chain will only be released from the ribosome in the **termination** phase of translation

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The correct answer is **B** as statements **I** and **II** best describe ribosomes. They are found in all living cells and are composed primarily of ribosomal RNA and about a dozen proteins.

C and **D** are incorrect, as statements **III** and **IV** do not accurately describe ribosomes. It is the proteins that provide structure to the ribosome, ribosomal RNA is the catalytic site of translation and facilitates the binding of mRNA and tRNA. Ribosomes consist of two subunits of non-equal size known as the **small subunit** and the **large subunit**.

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The correct answer is **C** because this protein is destined for a **lysosome** and will be synthesised on ribosomes that are **bound** to the **endoplasmic reticulum** (ER). Any proteins destined for secretion, the cell membrane or lysosomes are **initially** produced on free ribosomes but a specific signal (which occurs at the beginning of the polypeptide chain) pauses translation until the free ribosome **binds** to the ER.

The other options are incorrect as these proteins are destined for either the mitochondria, cytosol (where glycolysis takes place) or nucleus (histones package DNA into nucleosomes). Consequently, these proteins are used **within the cell** and are synthesised on **free ribosomes**.

6

The correct answer is **C**: the lack of a nucleus is a defining cellular feature of prokaryotes, this allows transcription and translation to take place in the same cellular compartment (and at the same time) because there is **no nuclear membrane separating the DNA from the ribosomes**.

- **A** is incorrect, as the circular nature of the chromosome is not a defining reason why transcription and translation can be coupled; plasmid DNA can also be expressed in the same manner
- **B** is incorrect, as although free ribosomes can start translating a mRNA molecule whilst it is still being transcribed, they are also present in eukaryotic cells so it is not a defining reason
- **D** is incorrect, as introns are not present in prokaryotic DNA. The lack of introns means that prokaryotic mRNA can be made immediately available for translation processing

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The correct answer is **A** because, depending on the amino acid change, it is highly likely that the three-dimensional structure of the protein being produced will be different. If the change in shape is at or near the target region of an antibiotic molecule (i.e. the drug target site), it may prevent binding of the antibiotic so the bacteria becomes resistant.

- **B** is incorrect, as although mutations could result in a protein not being synthesised, this is more likely to cause **harm** to the **bacteria**, especially if it is an essential protein
- **C** is incorrect, as producing less of the target protein would actually make the bacterial cell more sensitive to the antibiotic
- **D** is incorrect, as it is **not the best answer**. Mutations **could** introduce a stop codon, which would result in a shortened non-functional polypeptide being produced, preventing antibiotic binding. However, as most antibiotics target key essential proteins a non-functional protein would cause **harm** to the **bacteria**

8

The correct answer is **D** because features **II**, **III** and **V** specifically relate to **tertiary structure**, these interactions are **not found** in secondary structure. In tertiary structure, folding is due to the interactions between R-groups (**side chains**) that can form disulphide bridges, hydrophobic interactions or ionic bonds (not listed here).

- **A** and **C** are incorrect, as features **I** (hydrogen bonds) and **IV** (alpha-helices) are also found in the secondary structure of proteins
- **B** is incorrect, as it does not include feature **III** (hydrophobic interactions)

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The correct answer is **D** because quaternary structure refers to how multiple polypeptide chains and often other non-polypeptide components fit together to form larger protein complexes

- **A** is incorrect, as it relates to tertiary structure (the three-dimensional shape of a **single** polypeptide chain)
- **B** is incorrect, as the formation and arrangement of complex shapes, such as beta-pleated sheets and alpha-helices, relates to the secondary structure of proteins
- **C** is incorrect, as the sequence of amino acids relates to the primary structure of a protein

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The correct answer is **C** because multiple copies of the same polypeptide chain can be made simultaneously from the same single mRNA molecule, therefore, the rate of translation increases.

- **A** is incorrect, transcription and translation are not coupled in eukaryotic cells (unlike in prokaryotic cells). The polysomes translate a mature mRNA that has left the nucleus
- **B** is incorrect, as although the length of mRNA molecule will influence translation dynamics in many ways, it does not tend to be a limiting factor for the cell, so this statement is not the most likely answer
- **D** is incorrect, as it is the process of alternative mRNA splicing (in eukaryotic cells) that allow structurally different polypeptides to be produced from the same mRNA. This takes place before the mRNA leaves the nucleus