

7.3 Translation

Question Paper

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

Time allowed: 60
Score: /49
Percentage: /100

Question 1a

a)
Messenger RNA (mRNA) and transfer RNA (tRNA) are important molecules required for the transcription and translation of proteins.

Contrast the structures of mRNA and tRNA.

[2 marks]

Question 1b

b)
Describe the role of tRNA in the process of translation.

[3 marks]

Question 1c

c)
Tobacco plants have been genetically modified to produce human haemoglobin. The first three triplets of the antisense strand of the human haemoglobin gene are:

ATG GTG CAT

Identify the anticodons of the corresponding tRNA molecule.

[1 mark]

Question 1d

d)

The base sequence below is found in a section of the mRNA strand used to synthesise an enzyme found in tobacco plants.

G U U A A A G U U U C A A C G A A A A C

Using the diagram, deduce how many different **types** of tRNA molecules would attach to the section of mRNA shown in the diagram?

[1 mark]**Question 2a**

a)

The table below shows some of the events which take place in protein synthesis.

A	mRNA nucleotides join with exposed DNA bases and form a molecule of mRNA
B	Peptide bonds form between the amino acids
C	tRNA molecules bring specific amino acids to the mRNA molecule
D	The introns are spliced from the pre-mRNA to produce mRNA
E	A ribosome attaches to the mRNA molecule
F	The two strands of a DNA molecule separate
G	The mRNA molecule leaves the nucleus

Identify the correct order of letters to show the sequence of events during protein synthesis, starting with the earliest.

[3 marks]

Question 2b

b)

Haemoglobin is a protein made of alpha and beta polypeptides. Each alpha polypeptide has 141 amino acids and each beta polypeptide has 146 amino acids.

Deduce the total number of peptide bonds present in one alpha polypeptide **and** one beta polypeptide.

[1 mark]

Question 2c

c)

Haemoglobin is a quaternary protein.

Describe the structures of haemoglobin that make it a quaternary protein.

[2 marks]

Question 2d

d)

State the types of bonding present in the different levels of protein structure.

[3 marks]

Question 3a

a)

Describe the function of ribosomes in protein synthesis.

[4 marks]

Question 3b

b)

Within a cell ribosomes can be found free or bound to structures.

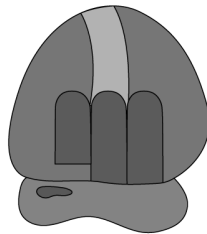
Contrast free ribosomes with bound ribosomes.

[2 marks]

Question 3c

c)

The image below shows the structure of a ribosome. Ribosomes contain an **A** site, an **E** site, and a **P** site.



Label the **A** site, the **E** site, and the **P** site on the image above.

[1 mark]

Question 3d

d)

Ribosomes are made of ribosomal RNA (rRNA). Messenger RNA (mRNA), transfer RNA (tRNA) and DNA are all involved in the synthesis of proteins.

Complete the table to show the differences between DNA, mRNA and tRNA.

Type of nucleic acid	Number of polynucleotide strands in the molecule	The nitrogenous base uracil present (✓) or not present (X)
DNA		
mRNA		
tRNA		

[2 marks]**Question 4a**

a)

Enzymes play an important role during transcription and translation.

Discuss the importance of enzyme-substrate specificity in the activation of tRNA molecules.

[4 marks]

Question 4b

b)

The tRNA-activating enzyme relies on phosphorylation.

Outline the role of phosphorylation during translation.

[3 marks]**Question 4c**

c)

Enzymes, such as the tRNA-activating enzyme, are proteins.

State, with named examples, **two** functions of proteins.

[2 marks]**Question 5a**

One mark is available for clarity of communication throughout this question.

a)

Describe how the process of translation leads to the production of a polypeptide.

[6 marks]

Question 5b

b)

Explain why cellular enzymes are made predominantly from protein.

[5 marks]

Question 5c

c)

Contrast protein synthesis in eukaryotes with protein synthesis in prokaryotes.

[4 marks]

