



BIOLOGY MIND

Edexcel

A-Level

BIOLOGY

Biological Molecules

DNA & Protein Synthesis 4

Time allowed

52 minutes

QUESTION PAPER



Score

/43

Percentage

%



DNA & Protein Synthesis

1 Messenger RNA (mRNA) and transfer RNA (tRNA) are important nucleic acids involved in the process of protein synthesis.

(a) Describe how a molecule of mRNA is made during transcription.

(4)

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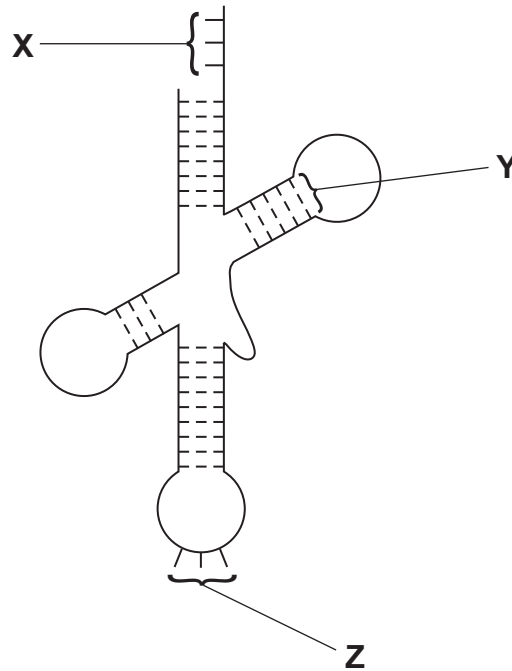
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(b) The diagram below represents a tRNA molecule.



For each of the statements below, put a cross (☒) in the box that corresponds to the correct statement.

(i) Part **X** binds to

(1)

- A** an amino acid for transcription
- B** an amino acid for translation
- C** mRNA for transcription
- D** mRNA for translation

(ii) Part **Y** is a

(1)

- A** glycosidic bond
- B** hydrogen bond
- C** peptide bond
- D** phosphodiester bond



(iii) Part **Z** binds to

(1)

- A** an amino acid during transcription
- B** an amino acid during translation
- C** mRNA during transcription
- D** mRNA during translation

(c) Using the information shown in the diagram, describe **two** ways in which the structure of a tRNA molecule differs from the structure of a mRNA molecule.

(2)

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2.....

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(Total for Question 1 = 9 marks)





DNA & Protein Synthesis

2 Nucleic acids, DNA and RNA, are very important molecules in living organisms. Messenger RNA (mRNA) and transfer RNA (tRNA) are involved in the synthesis of proteins.

For each of the statements (a) to (f), put a cross ☒ in the box that corresponds to the correct statement.

(a) DNA and RNA are polynucleotides composed of mononucleotides joined by (1)

- A catabolic reactions
- B condensation reactions
- C hydrolysis reactions
- D redox reactions

(b) The mononucleotides of RNA consist of a phosphate joined to the sugar (1)

- A deoxyribose
- B dextrose
- C ribose
- D ribulose

(c) The mononucleotides in mRNA are joined together by (1)

- A disulphide bridges
- B glycosidic bonds
- C hydrogen bonds
- D phosphodiester bonds



(d) The bases in RNA are (1)

- A** adenine, cytosine, guanine and thymine
- B** adenine, cytosine, guanine and uracil
- C** adenine, guanine, thymine and uracil
- D** cytosine, guanine, thymine and uracil

(e) DNA is a double stranded molecule twisted into (1)

- A** a beta-pleated sheet
- B** a double helix
- C** a triple helix
- D** an alpha helix

(f) The two DNA strands are held together by (1)

- A** disulphide bridges
- B** glycosidic links
- C** hydrogen bonds
- D** phosphodiester bonds



(g) Describe the role of each of the following in protein synthesis.

(4)

mRNA

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tRNA

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(Total for Question 2 = 10 marks)





DNA & Protein Synthesis

3 DNA is found in chromosomes and consists of double-stranded polynucleotide molecules. The sequence of bases in DNA forms the basis of what is known as the genetic code.

(a) Explain why a molecule of DNA can be described as a **double-stranded polynucleotide**.

(3)

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DNA & Protein Synthesis

*(b) Describe how the sequence of bases in a DNA molecule would be used to form the primary structure of a protein.

(5)

Lined area for writing the answer to the question.

(Total for Question 3 = 8 marks)

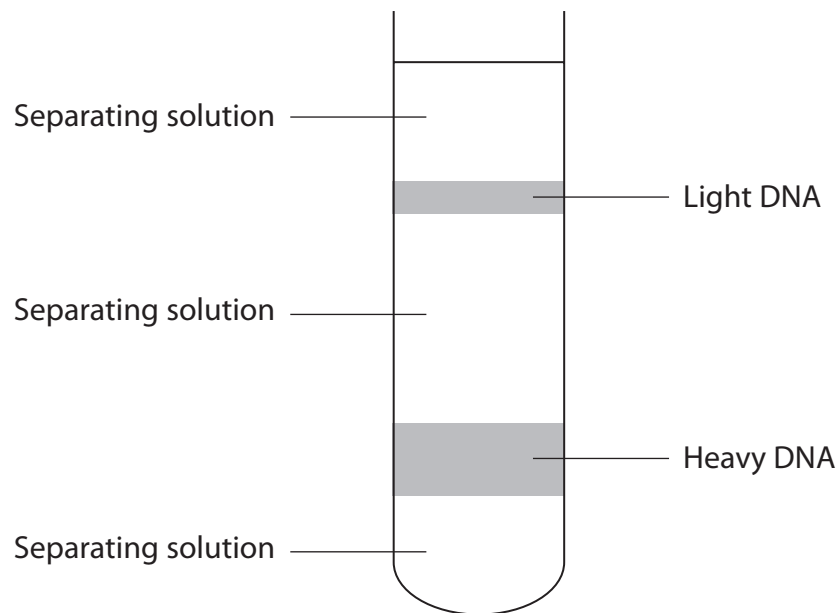


- 4 In the late 1950s, Meselson and Stahl performed some important experiments. These experiments provided evidence to support the idea that new DNA was synthesised by semi-conservative replication.

(a) Name an enzyme involved in DNA replication.

(1)

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- (b) Meselson and Stahl's experiments involved growing bacteria in culture media containing either heavy nitrogen (^{15}N) or light nitrogen (^{14}N). The DNA was then extracted from the bacteria. The DNA was analysed as shown in the diagram below.


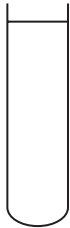
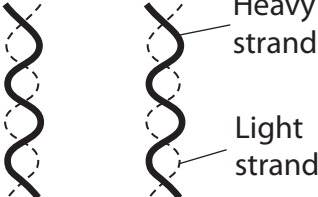
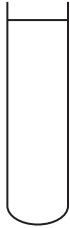



DNA & Protein Synthesis

The table below summarises the three stages of Meselson and Stahl's experiment and their results.

Complete the table by drawing, in the appropriate boxes, diagrams of the DNA molecules and mark the position and size of the DNA bands in the tubes.

(6)

Experimental stage	Diagram to show the strands in the DNA molecules of the bacteria	Position and size of DNA bands in the tube of separating solution
<p>Stage 1 Bacteria grown for several generations in culture medium containing heavy nitrogen</p>	<p>Heavy strands</p> 	
<p>Stage 2 The bacteria from the end of stage 1 were grown for another generation in culture medium containing light nitrogen</p>	 <p>Heavy strand</p> <p>Light strand</p>	
<p>Stage 3 The bacteria from the end of stage 2 were grown for one more generation in culture medium containing light nitrogen</p>		

(Total for Question 4 = 7 marks)





DNA & Protein Synthesis

5 The sequence of amino acids in a polypeptide chain is determined by the sequence of bases in DNA. This sequence of bases is used as a template to synthesise messenger RNA (mRNA).

(a) Describe the structure of an amino acid.

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(b) Describe how mRNA is synthesised.

(4)

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DNA & Protein Synthesis

(c) The table below shows the amino acids coded for by the codons on **mRNA**.

Three-letter codons of mRNA and the amino acids specified by the codons

AAU } Asparagine AAC }	CAU } Histidine CAC }	GAU } Asparatic acid GAC }	UAU } Tyrosine UAC }
AAA } Lysine AAG }	CAA } Glutamine CAG }	GAA } Glutamate GAG }	UAA } Stop UAG }
ACU } Threonine ACC } ACA } ACG }	CCU } Proline CCC } CCA } CCG }	GCU } Alanine GCC } GCA } GCG }	UCU } Serine UCC } UCA } UCG }
AGU } Serine AGC }	CGU } Arginine CGC } CGA } CGG }	GGU } Glycine GGC } GGA } GGG }	UGU } Cysteine UGC }
AGA } Arginine AGG }			UGA } Stop UGG } Tryptophan
AUU } Isoleucine AUC } AUA }	CUU } Leucine CUC } CUA } CUG }	GUU } Valine GUC } GUA } GUG }	UUU } Phenylalanine UUC }
AUG } Methionine			UUA } Leucine UUG }

The diagram below shows part of a messenger RNA molecule.



DNA & Protein Synthesis

- (i) Place a cross ☒ in the box next to the complementary sequence of bases found on the strand of the **DNA** molecule, from which part of this mRNA molecule was synthesised.

(1)

- A** G G T A A G C G C C T T
- B** G G U A A C G C G G A A
- C** A A C G G A U A U U G G
- D** A A C G G A T A T T G G

- (ii) Place a cross ☒ in the box next to the sequence of amino acids found in the polypeptide chain that is coded for by this part of the **mRNA** molecule.

(1)

- A** proline lysine alanine valine
- B** proline phenylalanine alanine valine
- C** glycine lysine arginine glutamine
- D** proline lysine alanine glutamine

- (iii) Place a cross ☒ in the box next to the final codon on this **mRNA** molecule if GUU is the last codon for an amino acid.

(1)

- A** AGU
- B** ACU
- C** UCA
- D** UGA

(Total for Question 5 = 9 marks)

