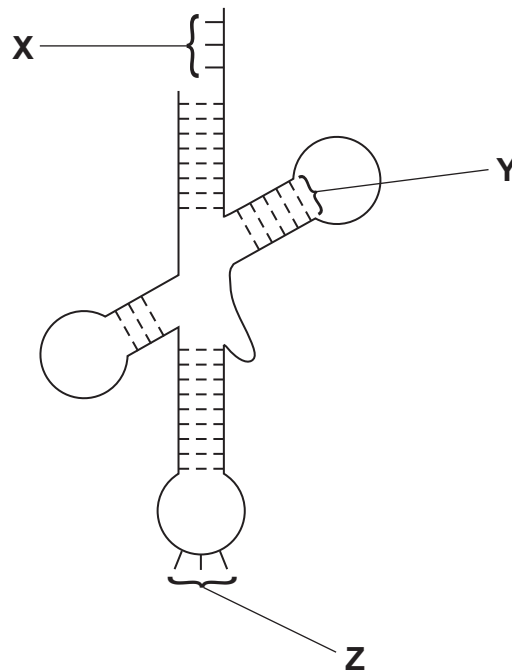


(b) The diagram below represents a tRNA molecule.



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)

1.....

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2.....

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(Total for Question 1 = 9 marks)

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)

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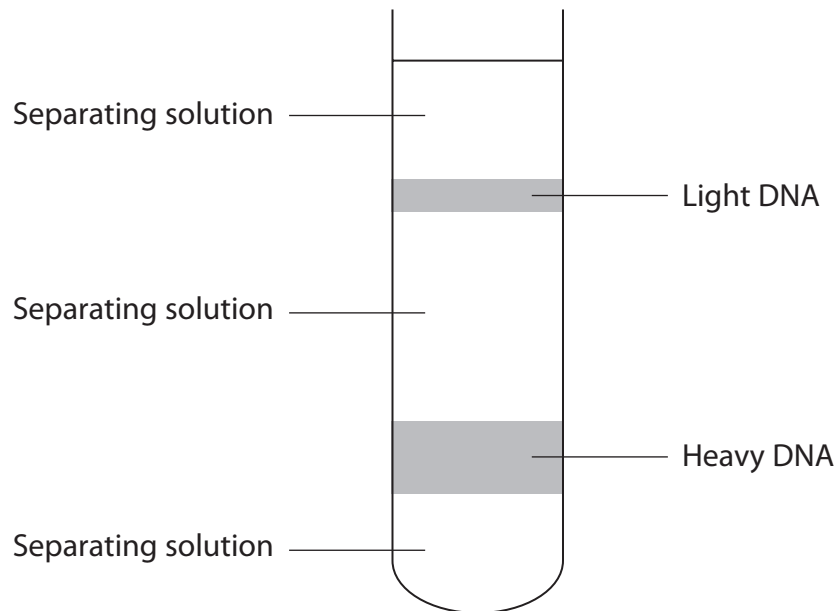
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4 In the late 1950s, Meselson and Stahl performed some important experiments. These experiments provided evidence to support the idea that new DNA was synthesised by semi-conservative replication.

(a) Name an enzyme involved in DNA replication.

(1)

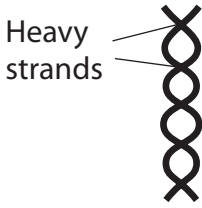

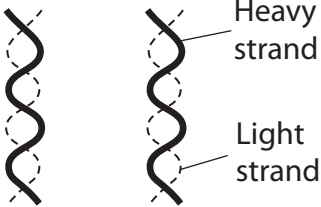


(b) Meselson and Stahl's experiments involved growing bacteria in culture media containing either heavy nitrogen (^{15}N) or light nitrogen (^{14}N). The DNA was then extracted from the bacteria. The DNA was analysed as shown in the diagram below.



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>Stage 2 The bacteria from the end of stage 1 were grown for another generation in culture medium containing light nitrogen</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)

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.

(2)

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(b) Describe how mRNA is synthesised.

(4)

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

The diagram below shows part of a messenger RNA molecule.



(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)