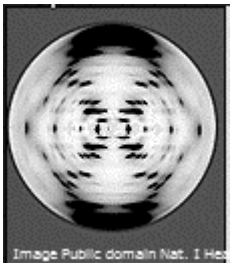
IB Style Test - Topic 7: Nucleic acids

Includes new elements of the 2016 guide

Multiple choice questions

1. The X-ray diffraction pattern obtained by Rosalind Franklin indicated that the structure of DNA had



   A. Complimentary base pairs
   B. A helical structure
   C. A backbone
   D. Nucleosomes

2. The structure of a ribosome includes

   I rRNA
   II Protein
   III Enzymes

   A I only
   B I and II only
   C I and III only
   D I, II and III

3. The role of DNA gyrase is to

   A. Rewind DNA after transcription
   B. Keep the DNA strands separate to allow base pairing
   C. Alter DNA bonding to allow helicase to unwind the DNA
   D. Form covalent bonds in the DNA backbone

4. Which of the following **do not** occur after transcription in **prokaryotes**?

   I Attachment of mRNA to a ribosome
   II Removal of introns
   III Movement of mRNA through the nuclear membrane

   A III only
   B I and II only
   C II and III only
   D I, II and III

5. A quaternary structure is found in some proteins because they have

   A. Many amino acids
   B. One polypeptide chain
   C. More than one polypeptide chain
   D. Enzymic properties

6. Which of the following sequences correctly describes tRNA activation?

A	ATP and a specific amino acid bind to t-RNA synthase	The specific tRNA with the correct anticodon binds to t-RNA synthase	The amino acid is attached to the tRNA and leaves the t-RNA synthase	The amino acid is activated using the ATP
B	The amino acid is activated using the ATP	ATP and a specific amino acid bind to t-RNA synthase	The specific tRNA with the correct anticodon binds to t-RNA synthase	The amino acid is attached to the tRNA and leaves the t-RNA synthase
C	The specific tRNA with the correct anticodon binds to t-RNA synthase	The amino acid is activated using the ATP	The amino acid is attached to the tRNA and leaves the t-RNA synthase	ATP and a specific amino acid bind to t-RNA synthase
D	ATP and a specific amino acid bind to t-RNA synthase	The amino acid is activated using the ATP	The specific tRNA with the correct anticodon binds to t-RNA synthase	The amino acid is attached to the tRNA and leaves the t-RNA synthase

7. The formation of mature mRNA after transcription involves:

   A. RNA polymerase
   B. Removal of exons
   C. Splicing
   D. Ribosomes

8. The role of the A site on the ribosome is for

   A. Forming a peptide bond
   B. Removal of the amino acid from the tRNA
   C. Causing the assembly of the large and small subunits of the ribosome
   D. Binding the mRNA codon to the tRNA anticodon

9. Non- coding regions of human DNA can be

   I Repetitive sequences
   II Regulators of gene expression
   III Transcribed into mRNA
   IV Telomeres

   A I only
   B 1, II and IV only
   C I and II only
   D all of them

10. Bioinformatics applications in databases containing information on DNA base sequences can be used to

    A. Identify homologous sequences in different species
    B. Identify infectious diseases
    C. Derive 3D protein structures
    D. Sequence a genome

Structured answer questions

11. Hershey and Chase were the first researchers to prove that nucleic acids are the genetic material, and not proteins. They used ^{35}S and ^{32}P as radioactive markers in virus cultures. Explain why they chose these markers. (3 marks)

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12. Describe why the Watson and Crick model of DNA structure also suggested a method for DNA replication. (3 marks)

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13. Draw a diagram of a polysome as it would appear under an electron micrograph. (3 marks)

14. Distinguish between the roles of proteins produced by free ribosomes and those produced by ribosomes attached to the rough endoplasmic reticulum. (2 marks)

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15. Variable number tandem repeats (VNTR) are short segments of repeating bases found in non-coding DNA. The number of repeats at certain places in the genomes of different individuals varies. Explain the significance of this variation in the number of repeats for DNA profiling. (4)

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16. Explain, using an example, how the environment can affect gene expression. (3 marks)

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17. Introns are removed from pre-mRNA leaving the exons to form mature mRNA. The arrangement of these exons can vary in some genes. Explain why this process of alternative splicing increases the number of polypeptide types that can be made from one DNA molecule. (3 marks)

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18. There are 20 kinds of aminoacyl t-RNA synthase enzymes that activate tRNA molecules prior to translation. Explain how this illustrates enzyme specificity. (2 marks)

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19. Describe the importance of prosthetic groups to the functioning of a protein. (2marks)

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20. Haemoglobin is a protein with 4 subunits, 2 α polypeptides, 2 β polypeptides and a haem prosthetic group containing iron for oxygen transport.
Haemoglobin E is abnormal form of haemoglobin with a point mutation in the β chain. There is no difference between the DNA base sequence for normal and E-type haemoglobin but the E type has glutamic acid in place of lysine at position 26 in the β chain.
The result of this substitution is a weakening of the attachment of the α and β chain causing instability in high oxygen concentrations

    a. Discuss why a change in the amino acid sequence may result in weaker bonding of the protein quaternary structure. (2 marks)

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    b. Explain how identical mRNA formed at transcription for both normal and E-type haemoglobin can result in the formation of a different polypeptide chain during translation of these mRNA variants (3 marks)

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Extension questions

1. Outline the functions of the following three enzymes:
   a. Helicase
   b. DNA polymerase I
   c. DNA ligase. (3 marks)

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2. Compare and contrast the functions of DNA polymerase I and DNA polymerase III in DNA replication (3 marks)

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