

7.1 DNA Structure & Replication

Question Paper

Course	DP IB Biology
Section	7. Nucleic Acids (HL Only)
Topic	7.1 DNA Structure & Replication
Difficulty	Medium

Time allowed: 60
Score: /50
Percentage: /100

Question 1a

a)
Some DNA is associated with a protein called histone, which packages the DNA into structures called nucleosomes.
Describe the structure of a nucleosome.

[2 marks]

Question 1b

b)
State the functions of nucleosomes.

[2 marks]

Question 1c

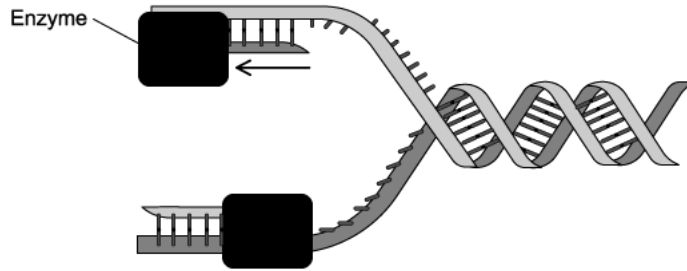
c)
Within the nucleus, DNA is replicated semi-conservatively in order to produce new cells.

State **two** features of DNA and explain how these features are important in the process of semi-conservative replication of a cell's DNA.

[2 marks]

Question 1d

d)
The diagram below shows DNA replication.

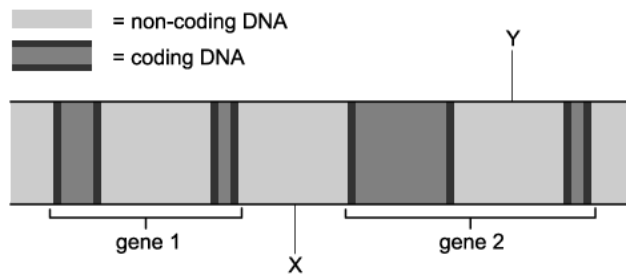


Name the enzyme shown in the diagram and describe its function.

[3 marks]

Question 2a

a)
The diagram below illustrates a small section of a DNA molecule from the nucleus of a eukaryotic cell.



State the structures labelled X and Y.

[2 marks]

Question 2b

b)

A repetitive sequence of DNA occurs at the ends of eukaryotic chromosomes, called a telomere.

Explain the role of a telomere.

[2 marks]

Question 2c

c)

Most of the DNA in an organism is contained within the nucleus. Some of this DNA is unique, whilst some is made up of highly repetitive sequences.

Contrast unique and highly repetitive sequences of DNA

[3 marks]

Question 2d

d)

DNA was originally thought of as a protein. In the 1950s, Alfred Hershey and Martha Chase showed that DNA is a factor of heredity responsible for carrying genetic information from one generation to another.

Describe their experiment.

[3 marks]

Question 3a

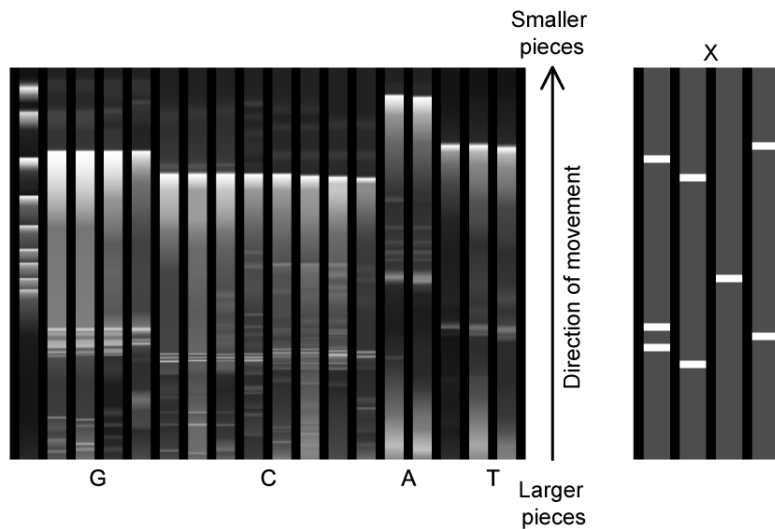
a)
The sequence of DNA can be determined by a machine and technique developed by Frederick Sanger, called the dideoxynucleotide chain termination method.

Describe how nucleotides containing dideoxynucleic acid stop DNA replication.

[3 marks]

Question 3b

b)
The chain termination process can be used to identify the sequence of base pairs.



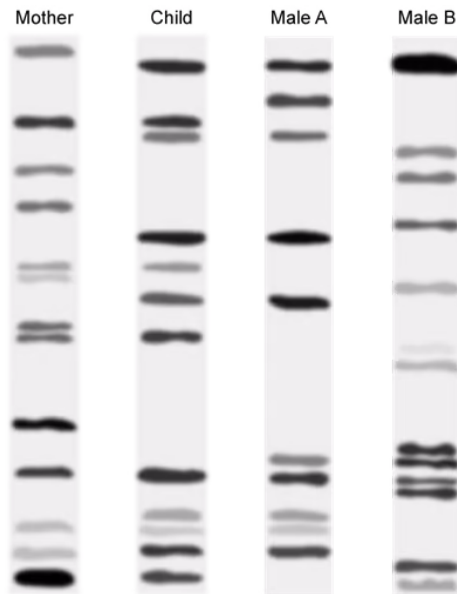
Use the image above to identify the order of bases, starting with the smallest, in the block of DNA labelled X, on the right.

[1 mark]

Question 3c

c)

Results from a paternity test using gel electrophoresis are shown in the image below. DNA was isolated from a mother, her child and two potential fathers. Primers designed to amplify different satellite DNA regions were used and amplified alleles are shown in the results below.



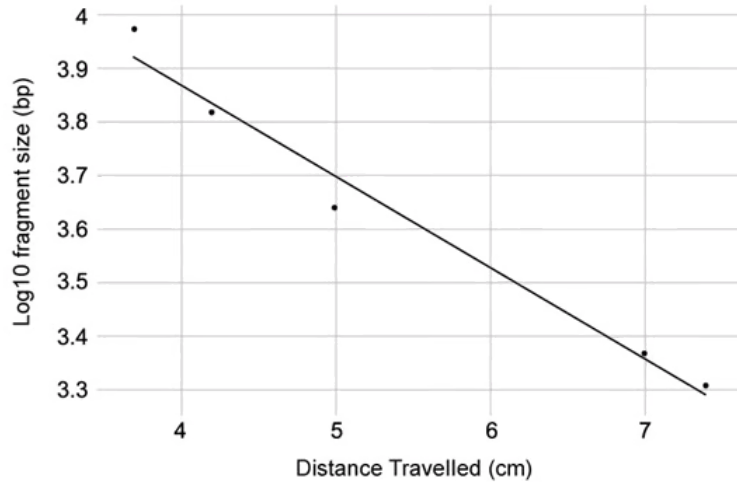
Use the gel electrophoresis DNA profiles in the image above to determine which male is the child's father.

[1 mark]

Question 3d

d)

The DNA fragments separated in the gel electrophoresis in part (c) vary in size from 100 bp (base pairs) up to 5 000 bp. DNA fragments of known size were used to create the plot shown in the graph below.



Use the line of best fit on the graph to determine the base pair length for DNA fragments that travelled 5 cm on the gel electrophoresis plate. Give answers to the nearest whole number.

[2 marks]

Question 4a

a)

DNA was studied by X-ray diffraction by Rosalind Franklin and Maurice Wilkins in the 1950's.

Explain how X-ray diffraction allowed Franklin and Wilkins to view the molecular structure of DNA.

[3 marks]

Question 4b

b)

Today, visualisation software can be utilised to analyse DNA in very high detail. The association between protein and DNA within the nucleosome can be seen.

Describe what may be visualised when analysing a nucleosome.

[3 marks]

Question 4c

c)

Many visualisation techniques have been used to understand and study the structure of DNA. Watson and Crick used visualisation techniques, such as Franklin's X-ray diffraction, to build a physical model of DNA. Their models were also influenced by the findings of other researchers, such as Erwin Chargaff.

Describe how the research findings of Franklin and Chargaff facilitated Watson and Crick to determine the structure of DNA.

[3 marks]

Question 5a

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

a)

Outline the steps of DNA replication at a replication fork, describing the role of each of the enzymes involved.

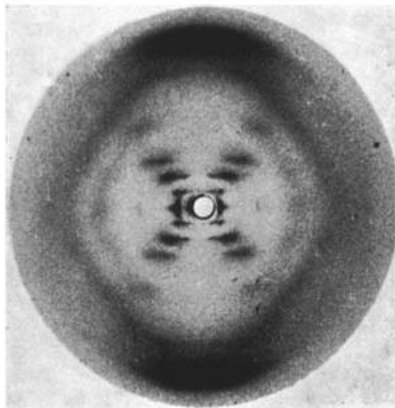
[6 marks]

Question 5b

b)

Rosalind Franklin's X-ray diffraction helped to determine the double-helix structure of DNA.

Describe the deductions Franklin made from the images she produced by X-ray diffraction.



[4 marks]

Question 5c

c)

Draw a labelled diagram to show four DNA nucleotides, each with a different base, linked together in two strands.

[5 marks]