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INTERNATIONAL SECONDARY CERTIFICATE EXAMINATION
NOVEMBER 2022

EXAMINATION NUMBER

[illegible]

100 marks

- This question paper consists of 16 pages and a Source Material Booklet of 15 pages (i–xv). Please check that your question paper and Source Material Booklet are complete. Remove the Source Material Booklet from the middle of the question paper.
- The question paper consists of three questions. Question 1 and 2 are case studies and Question 3 is an essay.
- Read the sources provided in the Source Material Booklet and use this information and your own knowledge to answer all the questions.
- Read the questions carefully.
- Answer ALL the questions on the question paper and hand this in at the end of the examination. Remember to write your examination number in the space provided.**
- Refer to the mark allocation for each of the questions in Question 1 and 2 as an indication of the detail required.
- It is in your own interest to write legibly and to present your work neatly.
- Four blank pages (pages 13–16) are included at the end of the paper. If you run out of space for a question, use these pages. Clearly indicate the number of your answer should you use this extra space. Write this question number exactly as it appears on the question paper.

Question	1	2	3	Total
Marks	30	30	40	100
Marked				
Moderated				

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SECTION A**QUESTION 1**

Refer to pages ii–v of the Source Material Booklet. Use this information as well as your own knowledge to answer the questions that follow.

1.1 Give the correct scientific term for a sex chromosome.

(1)

1.2 Name THREE different 'ingredients' needed for DNA replication by the Sanger method.

(3)

1.3 The allele causing Hunter syndrome can occur due to various mutations.

1.3.1 Explain what you understand by the phrase 'position 200' of the gene.

(1)

1.3.2 Explain why replacing one nucleotide with another could result in a different protein being coded for.

(3)

1.3.3 Draw a diagram to represent a nucleotide. Use any appropriate shapes to represent the different components. No heading is required.

1.4 Write down the correct term given **in bold between brackets** that applies in each of the following statements.

1.4.1 The Human Genome Project identified the (**function** / **sequence** / **number of alleles**) of all human genes.

_____ (1)

1.4.2 How many different colours of dye would be required for Sanger sequencing? (**four** / **five** / **six**)

_____ (1)

1.4.3 DNA replication occurs prior to (**meiosis I** / **meiosis II** / **anaphase**).

_____ (1)

1.5 Questions 1.5.1 to 1.5.4 below refer to Figure 1.5 on page v of the Source Material Booklet.

1.5.1 Explain clearly what is meant by the statement that Hunter syndrome is a sex-linked, recessive condition.

_____ (2)

1.5.2 State the numbers representing all the females in this pedigree who are most likely carriers of the allele for Hunter syndrome based on the appearance of their children.

_____ (2)

1.5.3 Individual 15 married a woman who was homozygous normal. They plan to have children.

- (a) Draw a genetic diagram or a Punnett square to show the expected results of this cross. Use the symbols shown in the pedigree in Figure 1.5 on page v.

(4)

- (b) State the expected percentage of each possible phenotype occurring in the offspring.

(2)

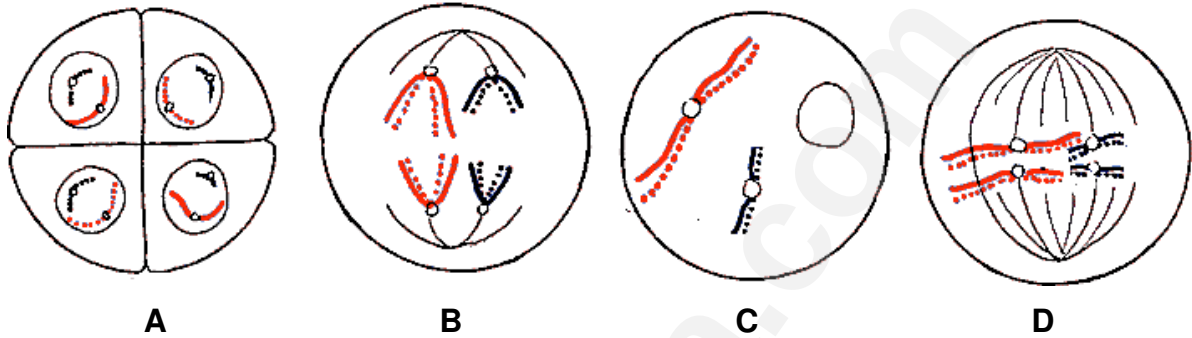
- (c) What is the chance of either of their sons inheriting the disorder?

(1)

1.5.4 Considering the information in the text and the pedigree diagram, evaluate whether the type of Hunter syndrome in this family is the severe or the mild type. Justify your answer.

- 1.6 Study the following diagrams depicting the process of meiosis. When a person with Hunter syndrome produces gametes they have a 50% chance of passing on the condition to their children.

Which diagram below represents the stage of meiosis where it is determined that only 50% of the gametes will receive the allele for Hunter syndrome. Write only the letter of your answer.



(2)
[30]

QUESTION 2

Refer to pages vi–viii of the Source Material Booklet. Use this information as well as your own knowledge to answer the questions that follow.

2.1 Where in a cell is DNA located?

(2)

2.2 Explain, in the form of a flow diagram, how the process of DNA replication takes place.

(5)

2.3 Study Figure 2.1 on page vi showing the family pedigree.

2.3.1 What is a chromosome?

(2)

2.3.2 Why would someone's saliva hold 'remnants of DNA'?

(2)

- 2.3.3 Explain why Y chromosome analysis, rather than mitochondrial DNA analysis, was used in this case.

(4)

- 2.4 During the analysis of the DNA, PCR would have been conducted. What is the relevance of this process in the context of the source?

(2)

- 2.5 Study Figure 2.3 on page vii showing DNA profiles made using samples taken from the saliva of Philip, Abshir, David and Dube.

- 2.5.1 What is meant by a 'DNA profile'?

(2)

- 2.5.2 Explain why non-coding DNA is used to make DNA profiles.

(2)

- 2.5.3 Identify with reasons/evidence from the DNA profiles who Philip's biological father is.

(3)

- 2.6 The Nobel Prize in Physiology and Medicine was awarded jointly to Francis Crick, James Watson and Maurice Wilkins in 1962 for their discoveries concerning the 'molecular structure of DNA and its significance for information transfer in living material'.

2.6.1 What did they discover about the 'structure of DNA'?

(1)

2.6.2 What is meant by 'information transfer' in this context?

(2)

- 2.7 Many new biotechnology companies advertise that they will be able to identify genetic relationships within families. Are investigations such as these ethical? Justify your answer.

(3)

[30]

60 marks

SECTION B**QUESTION 3**

Consider the following question:

Does the life-saving potential of embryonic stem cell research outweigh the concerns around the destruction of human embryos?

Using the source material provided as well as your own knowledge, discuss whether you agree or disagree with the question in the form of an essay of 2½–3 pages.

In your response you are expected to:

- Read the source material carefully.
- You must clearly agree or disagree with the question.
- Plan your essay before you start writing. Your plan will be marked.
- Present a debated argument, using relevant information from sources A–F as well as your own knowledge of Biology, to support your point of view.
- Arrange the information to best develop your argument.
- Write in a scientifically appropriate way.
- **In your essay, ensure that you have discussed at least eight different facts from the sources.**

40 marks

Total: 100 marks

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