



LIFE SCIENCES: PAPER II

Time: 2 hours

100 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 5 pages and a Source Material Booklet of 18 pages (i–xviii). Please check that your question paper is complete. Remove the Source Material Booklet from the middle of the question paper.
 2. The question paper consists of three questions. Question 1 and Question 2 are case studies and Question 3 is an essay.
 3. Read the sources provided in the Source Material Booklet and use this information and your own knowledge to answer all the questions. All the sources cited in the Source Material Booklet are referenced in Reference list starting on page xvii.
 4. Read the questions carefully.
 5. All questions must be answered in the Answer Book provided.
 6. Please start **each question** on a **new** page and leave lines open between all sub-questions (e.g., 1.1 and 1.2).
 7. Number the answers exactly as the questions are numbered.
 8. Use the total marks that can be awarded for each part of the questions in Questions 1 and 2 as an indication of the detail required.
 9. It is in your own interest to write legibly and to present your work neatly.
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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 Explain the meaning of the following terms:

1.1.1 Genetic counsellor (2)

1.1.2 Chromosome (2)

1.2 Study the following table that consists of rows with two items (numbered 1 and 2) in the second column and a biological term in the first column. These items are taken from the text and diagrams in the sources. Use your own knowledge and information from the sources and **decide which item(s) relate to each term.**

Write down your choice using the following codes:

- A** only item 1 relates to the term
- B** only item 2 relates to the term
- C** both items 1 and 2 relate to the term
- D** neither item 1 nor item 2 relates to the term

| Term | Item |
|------------------------------|--------------------------------------------------|
| 1.2.1 Chromosome 10 | 1. Autosome 2. Sex linked inheritance |
| 1.2.2 CEP | 1. Polygenic 2. Dominant gene |
| 1.2.3 Protein synthesis | 1. tRNA 2. mRNA |
| 1.2.4 Mutated <i>U1</i> gene | 1. Deletion mutation 2. Substitution mutation |

(4)

1.3 Provide a word from the text that means the same as the following statements:

1.3.1 Requires two of the same alleles to show the condition of CEP. (1)

1.3.2 Process of making mRNA from DNA. (1)

1.3.3 Change in nucleotide arrangement or sequence in DNA. (1)

- 1.4 Study Figure 1.5 on page iv showing the pedigree of a family with CEP. Provide the answer for each of the following statements based on the pedigree. Use the symbol 'A' for the normal allele and 'a' for the faulty allele.
- 1.4.1 Phenotype of female 1. (1)
- 1.4.2 Genotype of individual 3. (1)
- 1.4.3 Chance of parents 1 and 2 producing *another* child with CEP. (2)
- 1.5 Use the information provided in the source to calculate the number of people in South Africa out of 371 500 births expected to suffer from CEP. Show your working. (2)
- 1.6 Give a scientific explanation in terms of CEP for the following 'vampire' characteristics:
- 1.6.1 Presence of fangs. (1)
- 1.6.2 Drinking blood. (1)
- 1.6.3 Emerge only at night. (1)
- 1.7 CEP is a serious disease while 'vampires' have been portrayed as romantic or evil and powerful creatures in film and media. In your opinion, is this an offensive and unethical comparison? Give reasons for your answer. (3)
- 1.8 Refer to Figures 1.7 and 1.8 on page v showing CRISPR editing of the *U1* gene and a codon table.
- 1.8.1 From your own knowledge provide ONE difference between DNA and RNA. (2)
- 1.8.2 Provide the last two mRNA codons coded for by the corrected version of the *U1* gene in step 4 of Figure 1.7. (2)
- 1.8.3 The faulty *U1* gene has been changed by swapping the nucleotide G with A (as shown in step 4). Refer to Figure 1.8 to explain how this change leads to the correct amino acid (cysteine) being present, instead of the amino acid (arginine) in the defective *UROS* enzyme. (3)
- [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 Consider the following descriptions in the context of the sources. Provide the correct biological term from the sources for each description.
- 2.1.1 A building block of nucleic acids, consisting of a pentose sugar, joined to a nitrogenous base and a phosphate. (1)
- 2.1.2 The process of swapping alleles between the chromatids of homologous chromosomes. (1)
- 2.1.3 Cell division resulting in the halving of the ploidy/chromosome number. (1)
- 2.1.4 Chromosomes of the same length with the same genes present at the same locus. (1)
- 2.2 Male gametes carry either an X or a Y chromosome.
- 2.2.1 Refer to your knowledge of meiosis to explain how each gamete ends up with only one gonosome. (4)
- 2.2.2 What is the chance of a son inheriting his father's Y chromosome? Explain your answer. (2)
- 2.2.3 Explain why the level of genetic variation in the nuclear DNA in a population is higher than that of mtDNA in a population. (4)
- 2.3 Refer to the sources concerning the investigation into the Karretjie people.
- 2.3.1 Explain how the results of the mtDNA and Y chromosome haplogroup investigations support the maternal and paternal historical ancestry of the Karretjie people. (4)
- 2.3.2 Are the results of an investigation like this important to the people of South Africa? Justify your answer. (3)
- 2.4 Refer to Figure 2.6 on page viii.
- 2.4.1 What is a DNA fingerprint/profile? (2)
- 2.4.2 Why would non-coding DNA be used for the process of DNA fingerprinting/profiling? (2)
- 2.4.3 Use Figure 2.6 to determine the parents of baby 1 and baby 2. Justify your answers. (4)
- 2.4.4 Name ONE other application of DNA fingerprinting/profiling. (1)

[30]**60 marks**

SECTION B

Refer to pages ix–xvi of the Source Material Booklet.

QUESTION 3

Consider the following statement:

'Women's contribution to genetic studies have received more credit over time.'

Using the source material provided as well as your own knowledge, discuss your opinion on the statement in the form of an essay of 2½–3 pages.

In your response you are expected to:

- Read the source material carefully.
- Take a definite stand on the statement.
- Plan your essay before you start writing. Your planning will be marked.
- Present a debated argument. Use relevant information from Sources A–E as well as your own knowledge of Life Sciences 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 nine different facts from the sources.**

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|-----------------|
| 40 marks |
|-----------------|

Total: 100 marks