

**LIFE SCIENCES: PAPER II**

Time: 2 hours

100 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 6 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. Every source cited in the Source Material Booklet is referenced directly below the source.
 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 question 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–vi of the Source Material Booklet. Use this information as well as your own knowledge to answer the questions that follow.

- 1.1 Study the table below that consists of rows with a biological term in the first column and two items (numbered 1 and 2) in the second column. The terms 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(s) to each term.**

Write down your choice, using of 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	Items
1.1.1 PCR	1. DNA replication 2. RNA translation
1.1.2 Mutation	1. Loss of pieces of a chromosome resulting in a change in order of nucleotides 2. Insertion of a nucleotide in a gene
1.1.3 Chromatin network	1. 23 single chromosomes in a human somatic cell 2. All of the RNA and DNA in a cell

(3)

- 1.2 Study Figure 1.2 on page iii showing the first appearance of humans in different parts of the world. Explain how geneticists would use mtDNA technology to determine whether the first people in Europe had come from Asia. (3)

- 1.3 Study Figure 1.4 showing the piece of birch pitch containing the DNA found at Syltholm. Calculate the actual size of the piece of birch pitch. Show all workings. (3)

- 1.4 Explain the reason for researchers concluding that the DNA from the birch pitch was from a woman. (1)

- 1.5 Study Figure 1.5 on page iv showing the process of PCR.

- 1.5.1 Explain the reason for conducting PCR on the DNA collected from the birch pitch. (2)

- 1.5.2 Explain what is happening at the following steps of the PCR process:

(a) Step 1 (1)

(b) Step 3 (1)

1.6 The researchers then conducted DNA hybridisation on the sample of DNA. Table 1.1 on page v shows the results of this analysis.

1.6.1 What is the difference between a gene and an allele? (2)

1.6.2 Using the information in the table, state Lola's:

(a) skin colour;

(b) hair colour; and

(c) eye colour. (3)

1.6.3 Suggest how a study such as this one could assist in future archaeological research to learn more about human history. (2)

1.7 Study the pedigree in Figure 1.7 on page vi.

1.7.1 Is the X-linked condition recessive or dominant? Justify your answer. (2)

1.7.2 Using symbols X^R and X^r , provide the genotypes of the following individuals:

(a) line II individual 5; and (1)

(b) line II individual 6. (1)

1.7.3 Draw a genetic cross or Punnett square to show the chances of the next child born from the above individuals (line II number 5 and line II number 6) being born with Menkes syndrome. Write down the phenotype percentages of all the children that could result from the cross.

(5)
[30]

QUESTION 2

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

- 2.1 Provide a term from the sources that means the same as the following statements.
- 2.1.1 All of the DNA present in a species. (1)
- 2.1.2 The result of a cross between two individuals that differ in at least one characteristic. (1)
- 2.1.3 DNA that contains a gene from another species. (1)
- 2.2 Figure 2.3 A on page viii shows that there are very small populations of American chestnuts remaining. Explain how the genetic variation present in these small populations will affect the future survival of these natural populations. (3)
- 2.3 Figure 2.2 on page vii shows the importance of American chestnuts for humans and other species. Explain the ecological significance of its role in removing a lot of carbon dioxide from the air. (2)
- 2.4 In the sources (page x), it states that 'as the GM trees carry only one *O1* gene in each cell, half of the gametes they produce will carry this gene'.
- 2.4.1 Explain the difference in chromosome numbers between a somatic cell and a gamete. (2)
- 2.4.2 Explain in detail how the process of meiosis results in only half of the gametes produced by GM trees containing the *O1* gene. (4)
- 2.5 There are two methods currently being used to increase the number of American chestnuts – breeding for blight resistance, and genetic modification.
- 2.5.1 Which term below describes the process used in 'breeding for blight resistance' on page ix?
- A: natural selection
B: selective breeding
C: DNA profiling (1)
- 2.5.2 Draw a table of TWO clear differences between the process identified in Question 2.5.1 and the process of genetic modification. (4)

2.6 Study Figure 2.4 on page ix showing the process of genetic modification to insert the *O1* gene.

2.6.1 State what is occurring at the following steps:

(a) Step 1 (1)

(b) Step 3 (1)

2.6.2 Why are the plants with new traits regarded as clones? (1)

2.7 There has been a lot of opposition to planting GM American chestnut trees in the wild. This can be seen in Figure 2.5 on page x.

2.7.1 Do you support the idea that the presence of the OxO enzyme in the cells should be classed as a new fungicide (a poison that is used to treat fungal infections)? Justify your answer. (2)

2.7.2 Comment on the significance of the shape used for the stem of the tree in the infographic in Figure 2.5? (3)

2.7.3 In your opinion, should these genetically modified trees be planted in the forests of USA? Justify your answer. (3)
[30]

60 marks

SECTION B

Refer to Source A to Source F on pages xi–xviii of the Source Material Booklet.

QUESTION 3

Consider the following statement:

'Germline modification of human embryos should be legalised.'

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–F 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.**

40 marks

Total: 100 marks