



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 16 pages (i–xvi). 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. Read the sources provided in the Source Material Booklet and use this information and your own knowledge to answer Questions 1 and 2.
 3. Source material is also provided in the Source Material Booklet for the essay. Use this information and your own knowledge to first plan and then write your response.
 4. All questions must be answered in the Answer Book provided.
 5. Read the questions carefully.
 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 in the question paper.
 8. Use the total mark that can be awarded for each part of the questions in Question 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–iv of the Source Material Booklet.

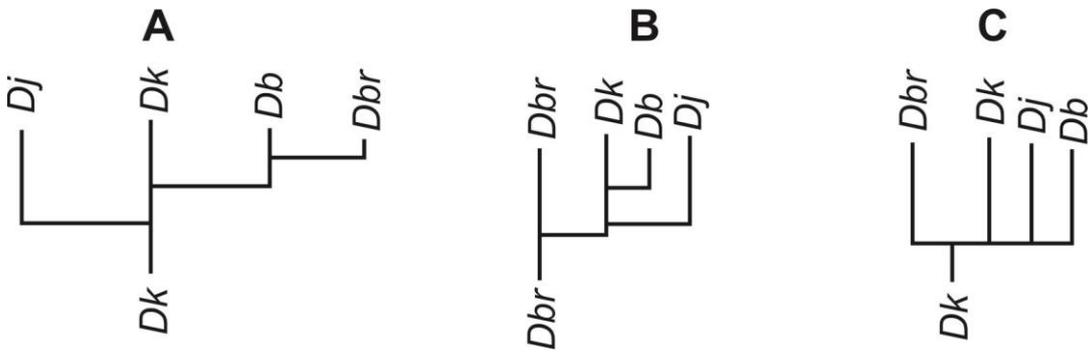
1.1. Using the information provided, state whether the following statements are **TRUE** or **FALSE**.

1.1.1 **Dk** is the newest species of giant groundsel. (1)

1.1.2 Allopatric speciation was responsible for the evolution of **Dm**. (1)

1.1.3 All the species of giant groundsel are more closely related to one another than to the species of giant lobelia. (1)

1.2 Consider the diagram on page iv of the Source Material Booklet. Which one of the following phylogenetic trees/cladograms shows the most correct relationships between **Dk**, **Dj**, **Db** and **Dbr**?



(2)

1.3 Giant groundsel and giant lobelias have various characteristics in common. Draw a table to provide the following information:

TWO adaptations of these plants to their environment; and an advantage of each of these adaptations. (6)

1.4 The text states that characteristics such as fast-growing woody stems resulted from convergent evolution in giant groundsel and giant lobelias.

1.4.1 What is convergent evolution? (2)

1.4.2 How would DNA analysis provide information that supports the idea that these characteristics are due to convergent evolution? (3)

- 1.5 Study the following table which consists of a phrase (*taken from the text*) in **COLUMN 1** and two biological descriptions/terms in **COLUMN 2**.

Decide which description/term from COLUMN 2 relates to the phrase in COLUMN 1.

Write the question number (1.5.1–1.5.3) and the LETTER of the correct description/term (A or B) in your Answer Book.

	COLUMN 1	COLUMN 2
1.5.1	Some seeds of <i>Dk</i> landed on Mount Meru and established a small isolated population.	A Founder effect B Polyploidy
1.5.2	The remaining small isolated patches of forest will also have a reduced level of genetic diversity.	A Increased heterozygosity B Increased homozygosity
1.5.3	DNA sequences	A Phenotype B Genotype

(3)

- 1.6 Explain ONE potential long-term effect of inbreeding on the survival of the small populations of giant groundsel. (2)
- 1.7 Calculate the mass (in grams) of ONE Mount Kenya giant lobelia seed. Show all working. (2)
- 1.8 Giant lobelias have an 'Out of Africa origin'. Which of the following options correctly describe the 'Out of Africa' hypothesis when referring to *Homo sapiens*? Write only the letter of your choice.
- A *Homo erectus* populations around the world diverged and when they met again, interbreeding resulted in the development of *Homo sapiens*.
 - B *Homo sapiens* evolved outside of Africa.
 - C *Homo sapiens* evolved in Africa and then spread throughout the world.
 - D A *Homo neanderthalensis* population entered Africa and evolved into *Homo sapiens*. (2)
- 1.9 Explain ONE way in which speciation on the mountains of East Africa can be compared to speciation on isolated islands such as the Galapagos Islands. (2)
- 1.10 Use information from the text to explain how climate change will influence the survival of giant groundsels and giant lobelias. (3)

[30]

QUESTION 2

Refer to pages v–vii of the Source Material Booklet.

- 2.1 Match the descriptions in column B (taken from the text) with the appropriate terms in Column A. Write only the number and appropriate letter on your answer sheet (e.g. 2.1.1 E).

Column A	Column B
2.1.1 Vestigial	A Two genetically distinct groups that are no longer able to interbreed successfully.
2.1.2 Different species	B When a mountain or some other physical barrier blocks the flow of genes, speciation could occur.
2.1.3 Gene flow	C Their eyes are present but are non-functional.
2.1.4 Allopatric	D Spread genes through a population

(4)

- 2.2 Provide a definition for **sympatric** speciation. (2)
- 2.3 Provide THREE pieces of evidence from the text that indicate that speciation in the Galilee mole rats is currently taking place. (3)
- 2.4 Explain how a gene in the Galilee mole rat may have become different in the two populations. (2)
- 2.5 List TWO reasons from the text that scientists could use to conclude that the changes observed in the two Galilee mole rat species are an example of microevolution. (2)
- 2.6 Jerry Coyne has a different explanation to that of Eviatar Nevo for the differences occurring between the two populations. Coyne is not convinced that sympatric speciation is occurring in the blind mole rats.
- 2.6.1 Why is it important that different scientists engage with each other in debate over proposed explanations of scientific observations? (3)
- 2.6.2 Why is it more difficult for scientists to demonstrate that new species have arisen by sympatric, rather than allopatric speciation? (2)
- 2.6.3 Name an example of sympatric speciation that you have studied. (1)

2.7 2.7.1 Explain in your own words how the mutant **p53** allele benefits the population of Galilee mole rats living in hard chalk soils. (3)

2.7.2 Study the following statements depicting the evolution of tolerance for low oxygen levels in the Galilee mole rat population living in hard chalk soils.

- A Surviving Galilee mole rats pass on mutation.
- B Mutation in p53 arises randomly in Galilee mole rat population.
- C Galilee mole rats that live in hard chalk soils and possess the mutation tend to be fitter than those without it.

Write down the letters of the statements in the order in which evolution occurs. (3)

2.8 mtDNA analysis indicates that the two groups of Galilee mole rat diverged about 0,2–0,4 million years ago.

2.8.1 Give ONE reason why scientists use mtDNA to determine relatedness between the two populations. (1)

2.8.2 Other than using DNA, provide TWO other lines of evidence that can be used to determine relatedness between different species. (2)

2.9 From your own knowledge, provide TWO reasons for why the theory of evolution is important for studying biological sciences. (2)

[30]

60 marks

SECTION B

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

QUESTION 3

Consider the following statement:

The need to access food efficiently, rather than a need for social cooperation, was the most important selection pressure for the evolution of a large brain in hominids.

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 plan will be marked.
- Present a debated argument, using relevant information from sources A to H 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.

40 marks

Total: 100 marks