NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2008

LIFE SCIENCES: PAPER II

Time: 2½ hours 150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 11 pages and a yellow booklet attached to the middle of your question paper. Please check that your question paper is complete. Detach the yellow booklet from the middle of your question paper.

2. Question 1 must be answered in the yellow booklet. Questions 2, 3, 4 and 5 must be answered in your Answer Book.

3. Read the questions carefully.

4. Number your answers exactly as the questions are numbered.

5. Use the total marks that can be awarded for each question in Questions 1, 2, 3 and 4 as an indication of the detail required.

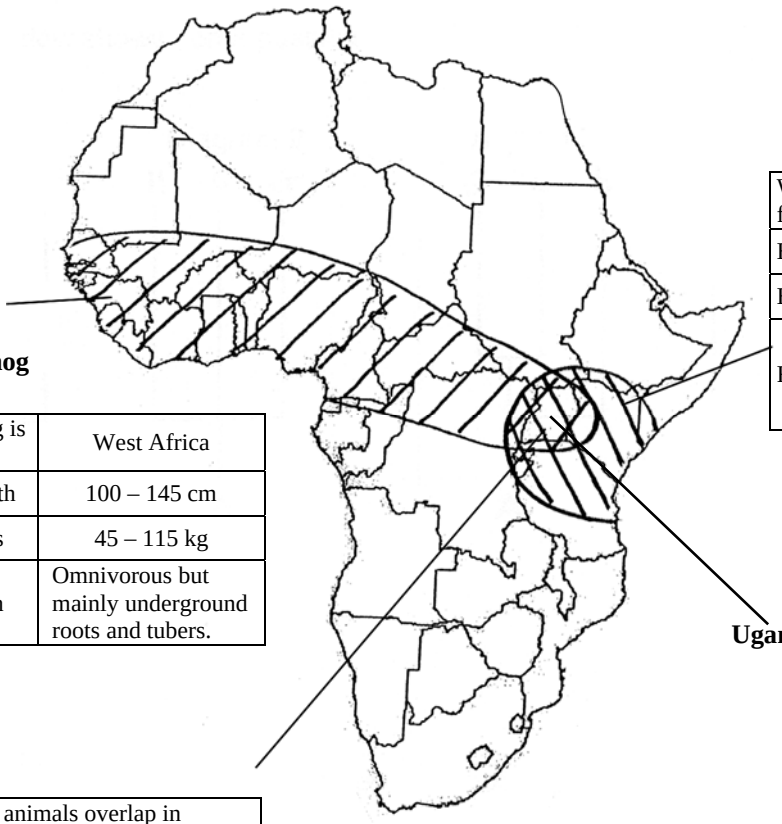
6. It is in your own interest to write legibly and to present your work neatly.

QUESTION 2

2.1

2.1.1 Explain what is meant by the term 'species'. (3)

The map below shows the African distribution of bush pigs and red river hogs which are similar to pigs. Use the information provided to answer the questions that follow.



Where hog is found	West Africa
Body length	100 – 145 cm
Body mass	45 – 115 kg
Food eaten	Omnivorous but mainly underground roots and tubers.

Where pig is found	East Africa
Body length	100 – 175 cm
Body mass	45 – 150 kg
Food eaten	Omnivorous but mainly under-ground roots and tubers.

Ranges of animals overlap in Uganda. In this area, populations of animals which have characteristics intermediate between those of bush pigs and red river hogs have existed for many years.

2.1.2 Give THREE pieces of evidence from the map above which suggests that bush pigs and red river hogs might belong to the same species. (3)

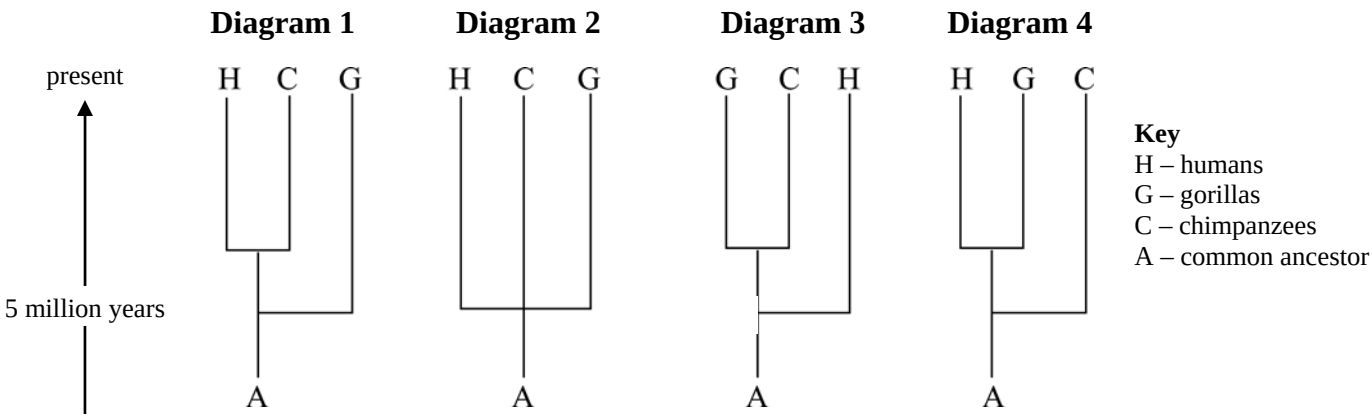
2.1.3 If the bush pig and the red river hog were two different species would they, in Uganda, be described as sympatric or allopatric? Explain your answer. (3)

2.1.4 There are pig fossils all over the world. What parts of a pig's body would have fossilised best? (2)

2.1.5 Scientists use fossils as evidence for explaining theories of evolution. Explain three properties of fossils that allow scientists to do this. (3)

2.2 Our present understanding of human evolution is that humans separated from an ape-like ancestor 5 million years ago. Fossil evidence for this is limited and to reconstruct the evolutionary past, we rely on comparing the DNA of present-day humans, gorillas and chimpanzees which are believed to have shared a common ancestor.

Diagrams 1 to 4 below shows some possible evolutionary pathways.



[Source: Bill Indge, *Advanced Level Biology*]

2.2.1 Compare diagrams 2 and 4 and give the differences between them. (3)

2.2.2 The table below shows the chromosome number in some primate species.

Species	Chromosome number
Human	46
Chimpanzee	48
Gorilla	48

Using just the evidence in the table above, which diagram (1 to 4) do you think shows the best evolutionary pathway of humans, gorillas and chimpanzees? Give a reason to support your answer. (3)

2.3 There have been five mass extinctions of living organisms on Earth and we are now in the middle of the sixth mass extinction.

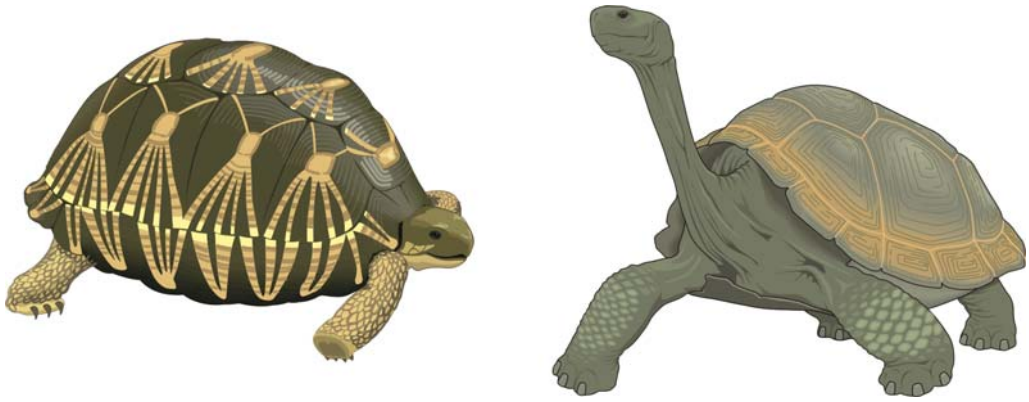
2.3.1 Explain what is meant by the term 'mass extinction'. (2)

2.3.2 What evidence is there that we are currently in the midst of the sixth mass extinction? (3)

2.4 There are two main varieties of tortoise on the Galapagos Islands. One has a domed shell and short neck and lives on the moister islands where the vegetation is mainly grass.
The long-necked variety lives on the drier islands where the vegetation mainly consists of tall shrubs and bushes. This variety has a shell which allows its long neck to be raised.

The diagram below shows the two main varieties of tortoise on the Galapagos Islands.

Short-necked variety **Long-necked variety**



[Adapted from *Higher School Certificate Examinations*]

Different theories of evolution were put forward by …

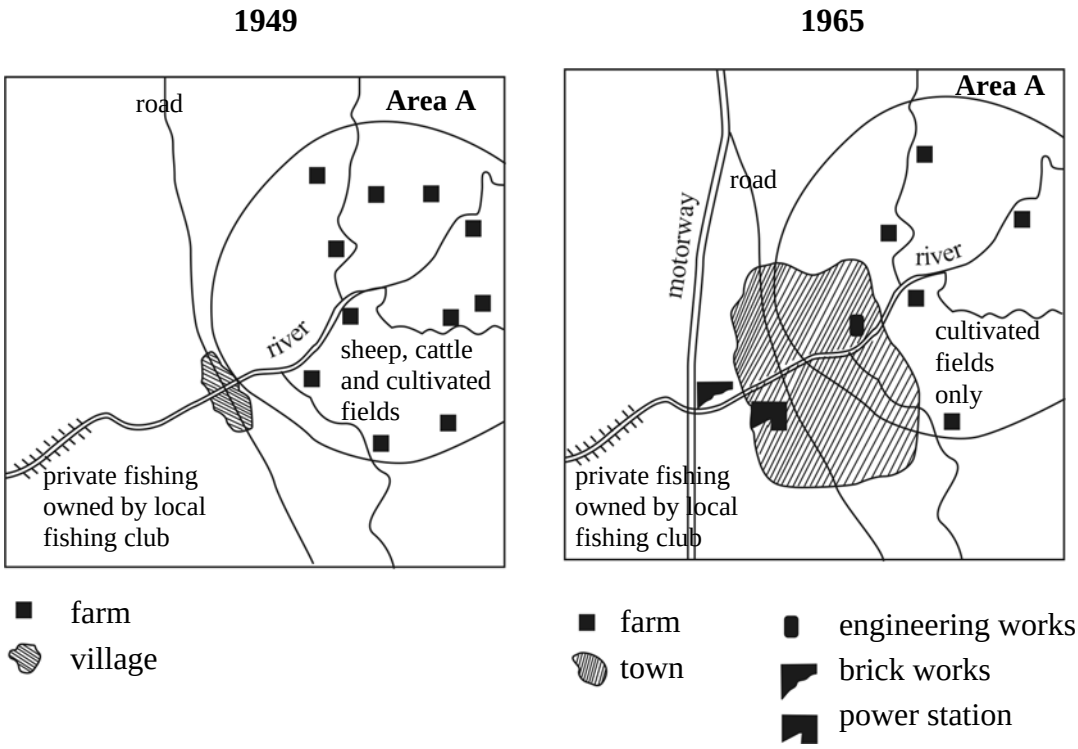
(a) Darwin and Wallace; and
(b) Lamarck.

Contrast these two theories by explaining the evolution of the long-necked variety of the Galapagos tortoise. (5)

30 marks

QUESTION 3

The maps below show the same area in 1949 and in 1965. In 1965 the farmers in area A stopped using farm manure and started adding synthetic chemical fertilisers to their fields. Refer to the maps to answer the questions that follow.



[Adapted from Clephane *Examination tests in Biology*]

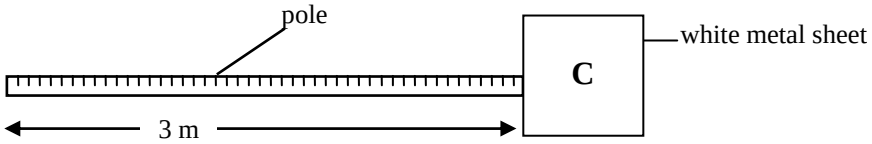
3.1

3.1.1 What are the main differences that you see between the area in 1949 and in 1965? (4)

3.1.2 Why was it necessary in 1965 for the farmers to use synthetic chemical fertilisers on their fields instead of manure? (2)

3.1.3 How could fertilisers have escaped into the river from the fields in area A? (2)

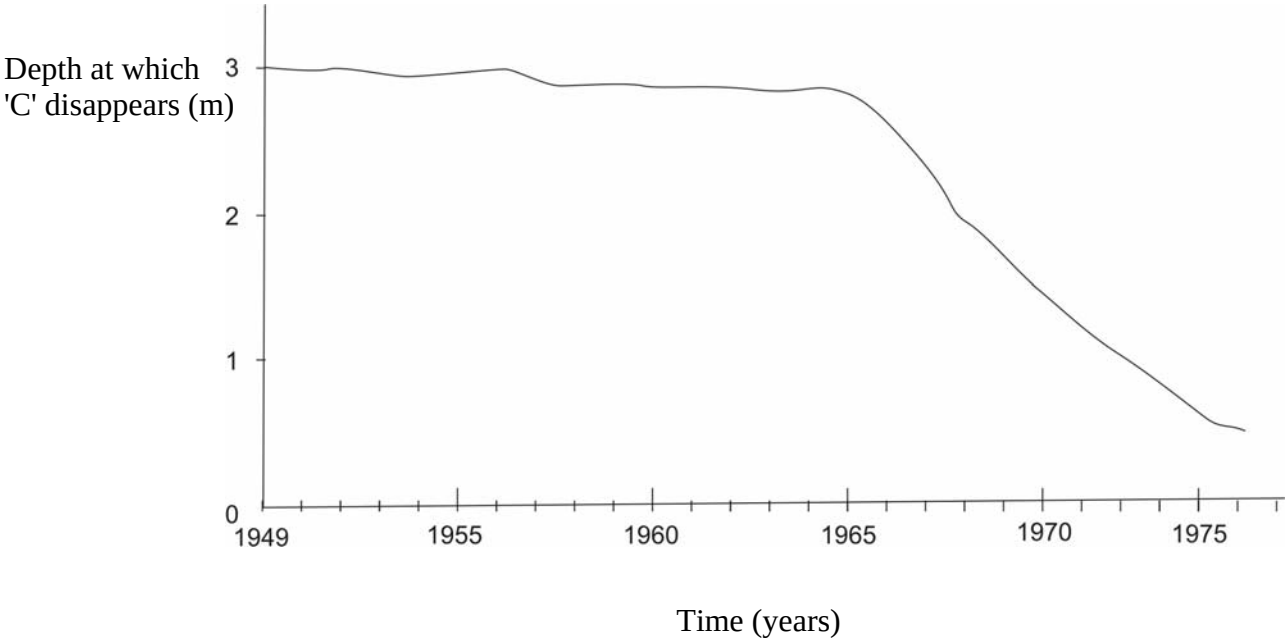
3.2 Mr Brown, a keen fisherman, joined the fishing club in 1948. Every year, he tested the quality of the water in a deep pool in the private fishing area with a 'Clarity Pole' he had made himself. This was a 3 metre long metal pole with a white metal sheet, of dimensions 30 cm × 30 cm, attached at right angles to the bottom end of the pole. The pole was marked in cm. Painted in black on the white metal sheet was the letter 'C', 20 cm long. Please see diagram below.



On 30 September each year, he stood in the same position, on a large rock at the edge of the pool. He lowered the metal sheet of the Clarity Pole into the water and measured the depth at which the 'C' disappeared, i.e. where he could no longer see it clearly. He recorded the depth in a table.

He repeated the test at the same time, on the same date each year.

The graph below shows the results of his measurements.



Mr Brown concluded that the quality of the water in the pool had decreased between 1949 and 1975. Was this conclusion based on good scientific investigation? Substantiate your answer. (10)

3.3 Mr Brown had noticed that the pool had become increasingly choked with a green water plant. He also noticed that the gills (the organs of gaseous exchange) of the fish in the pool had become slightly larger over a 25-year period.

3.3.1 What factors could have caused these changes? (4)

3.3.2 Design a management plan for this area to restore the water system to the condition as it was before 1965. (8)

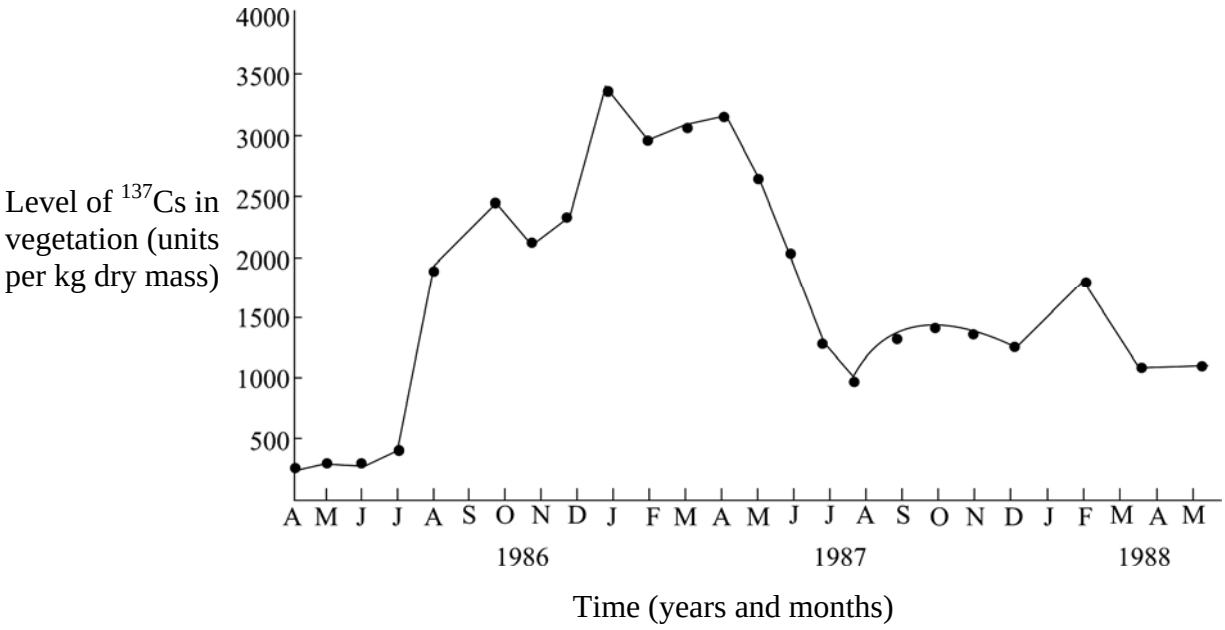
30 marks

QUESTION 4

4.1 Read the following information about the disaster at the Chernobyl nuclear power plant.

> The world's worst nuclear accident occurred at Chernobyl nuclear power station in southwest Russia on 26 April 1986. Large numbers of radioactive substances were released into the atmosphere. The radioactive substances produced were eventually deposited throughout the northern hemisphere. One of the worst affected areas in Britain was an area called Cumbria. This area received a lot of rain that washed the radioactive substances into the ground.
>
> Some radioactive substances last a long time in animals and plants and their concentration can be measured and recorded, e.g. Caesium-137 (^{137}Cs) lasts 37 years until it is no longer radioactive. Measurements of the radioactivity in lamb and mutton led to restrictions on the slaughtering of sheep in Cumbria. At first, the restrictions were to last for a three-week period. After three years, however, the restrictions on the slaughtering and sale of lamb and mutton were still in effect. The safety levels of radiation levels in meat are set at 1 000 units/kg.

Graph 1: Changes in amount of radioactive Caesium (^{137}Cs) from vegetation on a typical Cumbrian sheep farm, in Britain after the Chernobyl explosion.



[Adapted from MBV Roberts, *Biology Principles and Processes*]

4.1.1 What was the highest level of Caesium-137 measured in the Cumbrian vegetation? (1)

4.1.2 How many months after the Chernobyl nuclear accident did it take for the highest level of Caesium-137 to be measured in Cumbria? (1)

4.1.3 Why was the highest level of radioactivity measured in Britain a few months after the disaster had occurred? (2)

4.1.4 After the Chernobyl disaster, milk products from Cumbria were withdrawn from sale.
Draw a flow diagram (a series of short sentences separated by arrows) to explain why this was done. The first statement has been done for you below. (4)

[Radioactivity released from Chernobyl]

Read the following text and answer the questions that follow.

Radioactivity released from Chernobyl

Health problems arising from nuclear disasters depend on the amount of radioactive material released and the time over which it is released. The disaster at Chernobyl, in 1986, released low levels of radiation over many years while the atom bomb dropped in Hiroshima, in Japan in 1945, released a very large amount of radiation in just a few minutes. Over two hundred thousand people at Hiroshima died from the impact of the bomb by the end of 1945.

After Chernobyl, it is estimated that about four thousand people died from the effects. Most of these people were cleaners who were sent into the nuclear power station immediately after the disaster and who received high dosages of radiation. Children died as a result of thyroid cancers they developed after drinking contaminated milk in areas where it had rained and the radiation had entered the soil. Victims who survived the bombing at Hiroshima suffered a much higher rate of leukaemia than those who survived the Chernobyl disaster.

In both cases, at Hiroshima and Chernobyl, people lost their homes or were evacuated from high radiation level areas. This resulted in a disruption of social networks and victims suffered a social stigma of having been exposed to radioactivity. Evacuees from Chernobyl suffered widespread feelings of worry and confusion that resulted in high levels of stress, anxiety and physical symptoms that could not be medically explained.

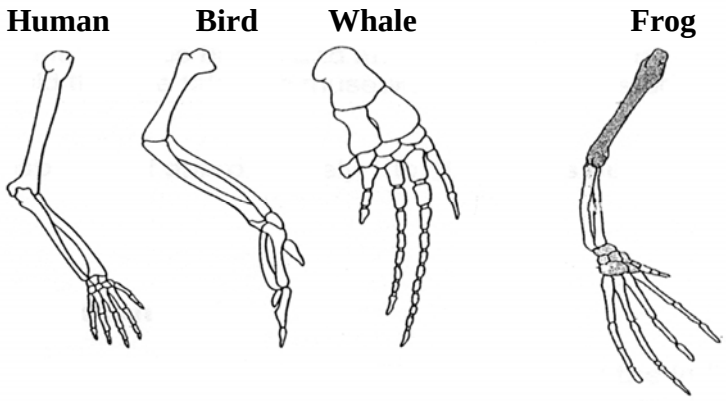
[Adapted from WHO report]

4.1.5 (a) It is usually thought that one of the major health problems arising from nuclear disasters is cancers of the body.
Do you agree with this opinion? Substantiate your answer. (4)

(b) A recent study has reached the following conclusion: USA soldiers exposed to radiation during nuclear testing in Nevada in the 1950s have higher than normal death rates for leukaemia and other cancers.
What comparisons needed to be made to reach this conclusion? (3)

4.1.6 South Africa is undergoing an energy crisis. The present power stations are run on coal, and are not able to meet the electricity needs of the country. Some politicians have suggested that South Africa should build more nuclear power stations. Other politicians feel that our present power stations should be renovated and additional ones constructed.
Which do you think is the most suitable solution to the energy crisis? Give FOUR reasons for your answer. (4)

4.2 Study the diagram below and answer the questions that follow.



4.2.1 What term is used to describe the arrangement of bones in vertebrate forelimbs? (1)

4.2.2 How is convergent evolution shown in the forelimb of a human, bird, whale and frog? (6)

4.3 Read the information below and answer the question that follows.

> The Vadoma are a tribe, of a small population, living in an isolated area to the west of Zimbabwe. More than half the tribe has a condition resulting in only two toes on each foot. A genetic mutation results in the middle three toes being absent and the outer two toes turned inwards.
>
> As a result of this condition, the tribe is known as being the 'two-toed' or 'ostrich-footed' tribe. The people with the two-toed condition are not handicapped and are accepted by the rest of the tribe. The condition helps people climb trees better than people with five toes. Due to the tribe's isolation and small gene pool, the condition is more frequent than would be found in larger tribes.

[Adapted from <www.thisisalllondon.co.uk>]

Could the entire tribe eventually consist of everyone being two-toed? Explain your answer. (4)

30 marks

QUESTION 5

Read the source material (A – E) provided in order to help you respond to the following question.

Should human bones and mummified remains be left where they are found in the environment or should they be taken to museums for scientific study?

Provide a written response of approximately 1½ to 2 pages outlining your decision and the reasons for it.

20 marks

SOURCE A EXAMINATION OF MUMMIFIED REMAINS AT A BURIAL SITE

In 1999 at Kouga in the Eastern Cape, a group of archeologists found the mummified remains of a Khoi-San man. The remains were found in a cool, dry rock shelter covered with the antiseptic leaves of a medicinal plant that is still widely used by indigenous people today. It is thought that the cool, dry conditions and the leaves helped preserve soft tissue such as muscle, skin and some lung tissue. The burial place was marked with a large flat stone on which were San paintings. After the plant matter was removed, a necklace of seed beads was found around the mummy's neck. The archeologists used a tape measure to measure bone lengths of the mummy in the grave. Although it is believed that mummification was not a general practice among the Khoi-San people, this conclusion is based on the Kouga mummy being the only mummified remains found until now in South Africa.

[Adapted from The Kouga Mummified Human Remains]

SOURCE B EXAMINATION OF THE MUMMIFIED REMAINS AT THE MUSEUM

After negotiation with Khoi-San community leaders and the Eastern Cape Provincial Government, the mummified remains were taken to a museum for further analytical and scientific study. Study of the long bones showed that growth had ceased. It was then determined that the mummified remains were that of a Khoi-San man, estimated to be between thirty and forty years old when he died. A variety of tissue samples was taken. Analysis of food remains in the abdominal cavity provided information about the type of food eaten. This in turn gave information about the diet, social and cultural events about how and when food was eaten as well as indicating areas the man visited while he was alive. The man's short stature of approximately 145 cm indicates that he was of San rather than of Khoi origin who were usually between 150 and 176 cm in height. DNA studies of soft tissues confirmed the San origin.

[Adapted from The Kouga Mummified Human Remains]

SOURCE C A MUSEUM ARCHEOLOGIST SPEAKS

'Each year we get phone calls about skeletons found when new roads are being built or when trenches are being dug to lay pipes for housing projects. We have travelled long distances to examine bones that have been unearthed. Many of these skeletons are of the recent past, having been buried in the last 60 to 100 years. Many people feel that unearthed bones should be reburied in local areas. What we do first is try to establish the date of burial by looking at written and verbal historical records. One problem is that there is often no one still alive in the local community who remembers old burial sites. Another problem is that many local communities kept verbal rather than written records of burial sites. With changes of land use verbal records get easily lost, especially when people move away from ancestral land areas. By law, however, where they have already been disturbed, bones have to be brought to the museum for safekeeping. Examining the bones helps us identify many features of the community that lived at the time. The museum has a policy in that no human remains are exhibited to the public.'

[Personal communication]

SOURCE D TRACING ANCESTRAL ROOTS

The common ancestor to all modern humans has been traced to the female Khoisan 'Eve'. This has been done using m-DNA (mitochondrial DNA), genetic material found in mitochondria, which are passed on from the egg cell to the zygote. Because a person's mitochondria are inherited from their mother, it is possible to trace back the m-DNA through the maternal line. It is now possible to determine the various populations which make up all South African people. Also, because mutation rates are known, scientists can compare DNA segments from different human populations and determine the oldest m-DNA. After studies comparing m-DNA, it was found that the oldest types of m-DNA are present in living Khoi-San people. Using m-DNA, it is also possible to show how humans evolved in Africa.

[Adapted from Human Origins – Evidence in the Genes]

SOURCE E A LOCAL RESIDENT SPEAKS

'I have lived with the bucket system all my life. Last year I was promised a flush toilet and I am still waiting. When the municipality dug for the pipes, they found a whole lot of old bones and the digging had to stop. What is the fuss about a whole lot of old bones? I want a flush toilet!'

[Personal communication]

Total: 150 marks