NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2008

LIFE SCIENCES: PAPER I

Time: 2½ hours 150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 9 pages. Please check that your question paper is complete. Detach the yellow booklet from the middle of the question paper.

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

3. Read the questions carefully.

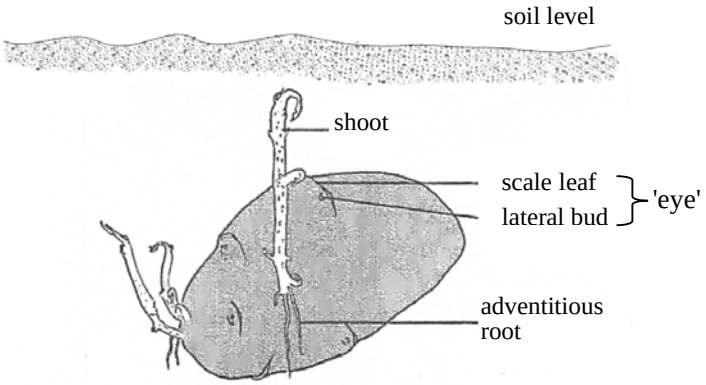
4. Number your answers exactly as the questions are numbered.

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

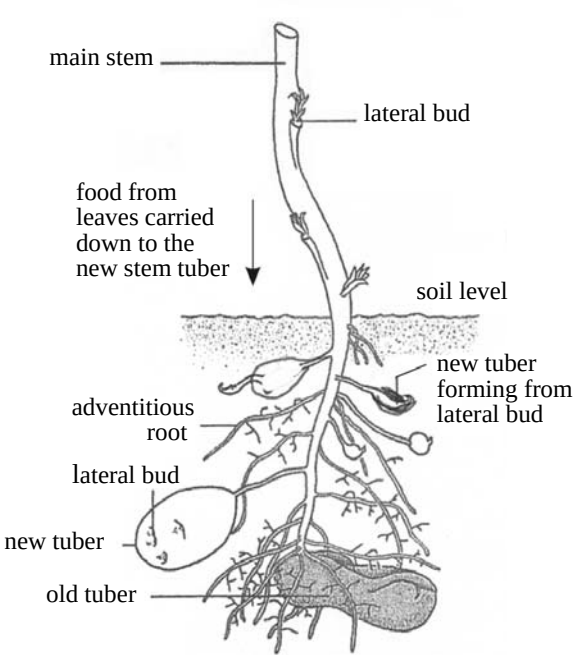
6. It is in your own interest to write legibly and to present your work neatly.

QUESTION 2

2.1 Study these diagrams of parts of a potato plant.



potato tuber sprouting



stem tubers growing on a potato plant

[Adapted from *CJ Clegg with DJ MacKean*]

2.1.1 Define asexual reproduction. (2)

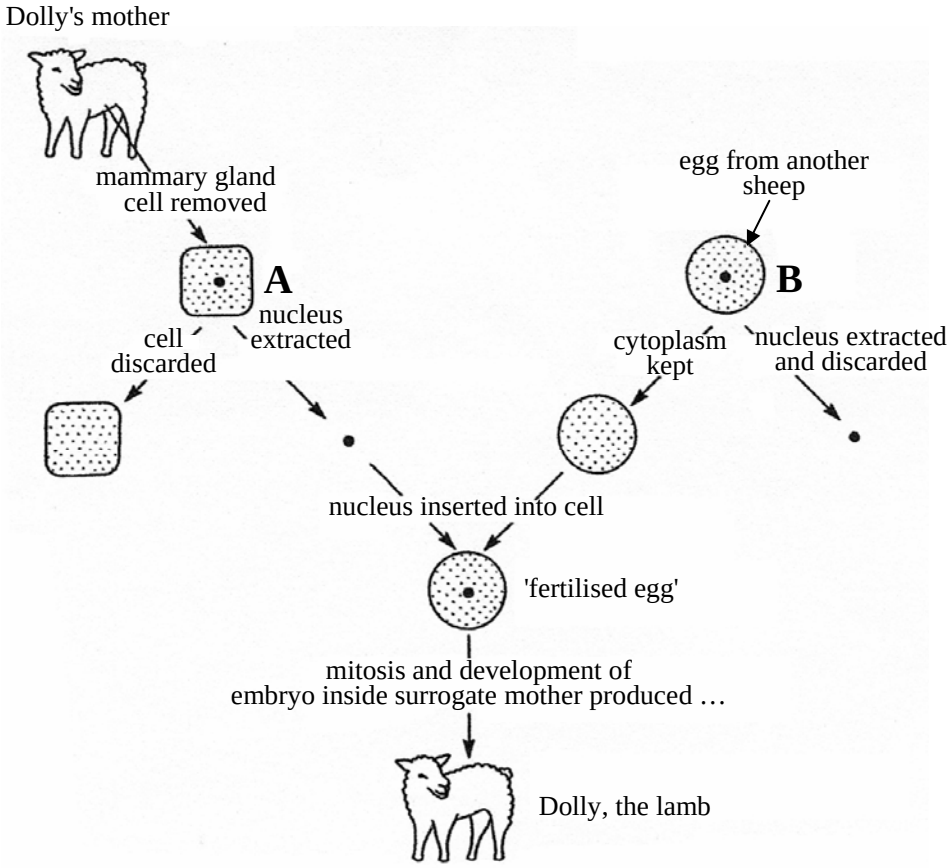
2.1.2 Use the information in the diagrams above to explain how a farmer (farmer A) could use her knowledge of asexual reproduction to grow more potatoes. (4)

2.1.3 Another farmer (farmer B) argues that his potatoes are more nutritious than farmer A's because their genotype is different. Design an experiment to provide evidence as to which argument is correct.

Set your experiment out as follows:
Hypothesis
Aim
Method (approximately 5 steps in the process) (8)

2.2 In 1997, scientists from the Roslin Institute in Scotland claimed that they had cloned a lamb from a cell taken from the mammary gland of a sheep. The lamb was called 'Dolly' and she became famous as she was the first mammal formed from a non-reproductive cell.

This diagram summarises the process the scientists used.



[Adapted from *James Torrence*]

2.2.1 Is cell A formed by mitosis or meiosis? Give a reason for your answer. (2)

2.2.2 Cell B is formed by meiosis.

(a) In which organ does this process take place? (1)
(b) Give the scientific name for the organ in which the embryo develops. (1)
(c) What is the usual function of a mammary gland? (1)

2.2.3 Explain why the 'fertilised egg' shown in the diagram above differs from a normal fertilised egg of a sheep. (3)

2.2.4 Some sheep farmers support this type of experiment. Why? Explain your reasons fully. (4)

2.2.5 Some people feel this type of experiment is unethical. Give an argument they could use to support their point of view. (4)

30 marks

QUESTION 3

3.1 Answer the following questions about the human male reproductive system.

3.1.1 Make a labelled diagram of one mature human sperm cell. Include in your diagram two important organelles. Label any three structures. (6)

3.1.2 Is the structure you have drawn haploid or diploid? What is the significance of this? (3)

3.2 Use the information below to assist you in answering the questions that follow.

Records of human fertility for the period 1930 to 1990 have shown changes in the sperm counts of normal men.
The table below summarises the changing percentages of the normal male population with high or low sperm counts over the period of sixty years. High sperm count is greater than 100×10^6 sperm per cm^3 of semen. Low sperm count is less than 20×10^6 sperm per cm^3 of semen.

Time period	Men with high sperm counts (%)	Men with low sperm counts (%)
1930-1950	50	5
1951-1960	45	4
1961-1970	28	14
1971-1980	21	11
1981-1990	15	18

[Adapted from *Jones and Jones*]

3.2.1 Name the specific part of the male reproductive system where sperm are stored. (1)

3.2.2 Describe the trends in fertility as shown by the figures in the table above. (4)

3.2.3 More information on this study is needed before any scientific conclusions can be reached from the figures. List FOUR variables which should have been controlled in this study and explain in each case why this control is necessary. (8)

3.2.4 In this experiment it was suggested that oestrogen-like compounds in the environment may have contributed to the results. These compounds are found in certain pesticides and detergents.

(a) Give ONE function of oestrogen in the human female body. (1)
(b) Pregnant woman could endanger their male foetuses by exposure to these chemicals. Explain how this is possible. (3)
(c) It is important for sex hormones to fluctuate within certain limits in the human female. Explain how the amounts of oestrogen in a female body influence the functioning of her reproductive system. (4)

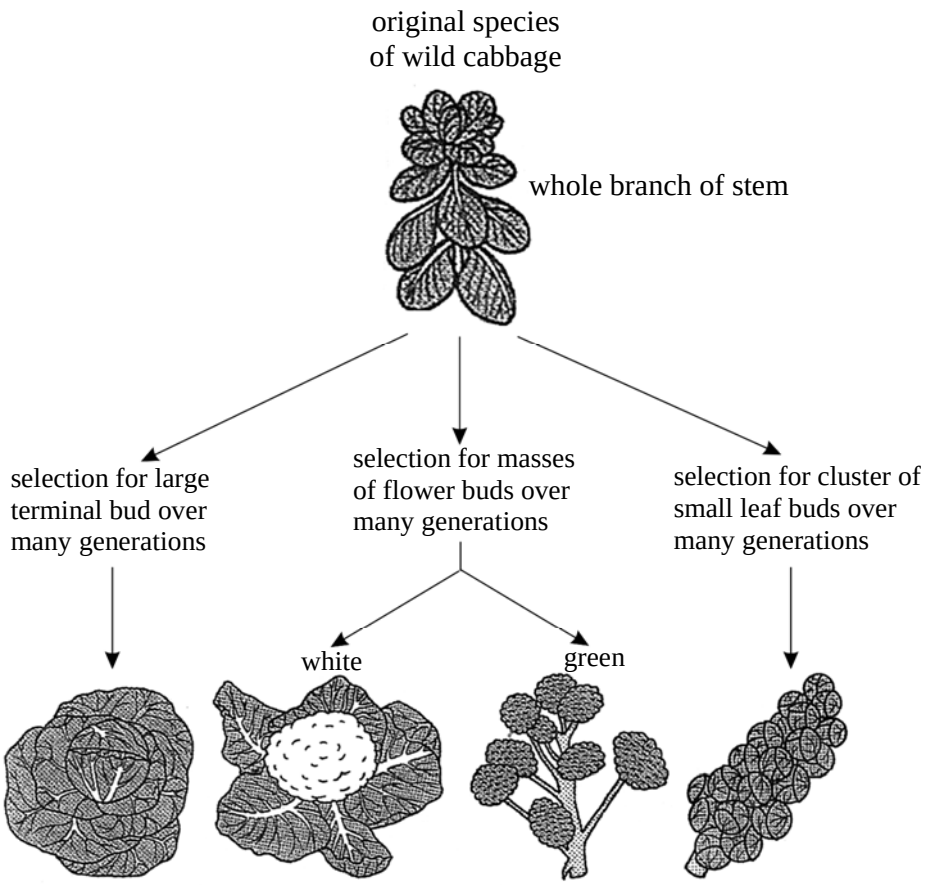
30 marks

QUESTION 4

4.1 Many years ago farmers noticed variations in the wild cabbage plants they were growing. They selected seeds from the varieties they particularly wanted to grow and planted these. Over many generations the wild cabbage developed into the plants shown below.

These plants are different varieties of the **same** species *Brassica oleracea*.

Detail of wild cabbage



[Adapted from *James Torrance*]

4.1.1 In about 3 800 BC the wild cabbage shown above was grown in large numbers as a food crop in China.
Give THREE important reasons for farmers selectively breeding the wild cabbage over many years into different varieties. (3)

4.1.2 Do you think that the five plants shown in the diagram above have the same number of chromosomes? Give a reason for your answer. (3)

Read the following two passages concerning genetic engineering and answer the questions that follow each passage.

4.2 Cancer cells develop from normal cells. Chemotherapy is one way to treat cancer. The drugs used in this treatment kill cancer cells, and have a reduced, yet harmful effect on normal cells. Trial experiments are being carried out which involve adding a new gene to the normal cells of the human body. The added gene produces a protein which protects the normal cells against the drug being used in the cancer treatment. As the protective protein is absent in the cancer cells, the drug acts on them and they die.

4.2.1 What are cancer cells? (1)

4.2.2 Genes are able to code for a particular protein. Describe the features of a gene which make this possible. (4)

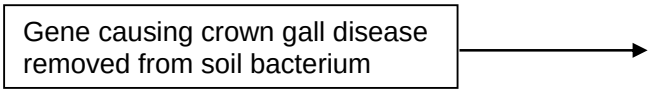
4.2.3 Describe briefly the process by which a protein is made from the 'new' gene that has been inserted into the cell. (7)

4.3 Crown gall disease in plants is caused by a soil bacterium. The infected plant develops a tumour (referred to as a gall) in its stem. The gall is caused by a short portion in a DNA strand in the bacterium, called a plasmid. Galls can grow large and kill the host plant. The modified plasmid can be isolated; its tumour-producing gene removed and a 'good' gene introduced in its place. This 'good' gene is introduced into the plant genome by the plasmid. The plant tissue can be stimulated to grow into whole plants which are called transgenic plants. These contain the 'good' gene which prevents crown gall disease.

[Adapted from *John Adds, Erica Larkcom and Ruth Miller*]

4.3.1 What is a 'transgenic plant' as described in this passage? (2)

4.3.2 Make a flow diagram (series of words or short sentences separated by arrows) to show the process by which a transgenic plant is formed. Copy the first step which is given to you below and complete the flow diagram in your Answer Book. (4)



4.3.3 Use the information provided in the extract above to write a motivation for funding of a transgenic plant project in fruit orchards in the Cape to prevent the growth of crown gall disease. Limit your answer to one paragraph. (6)

30 marks

QUESTION 5

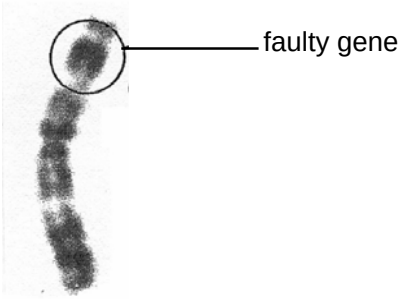
You are the parent of a child with the disease cystic fibrosis and are thinking of having a second child. Use the information given below (A, B, C and D) and in Question 1.3 to help you decide what you should do. Provide a written response of not more than two pages outlining your decision and the reasons/ motivation for it.
Select only the facts from the information given that will assist your answer, do not attempt to use all the facts.

20 marks

INFORMATION TO USE IN ANSWERING QUESTION 5

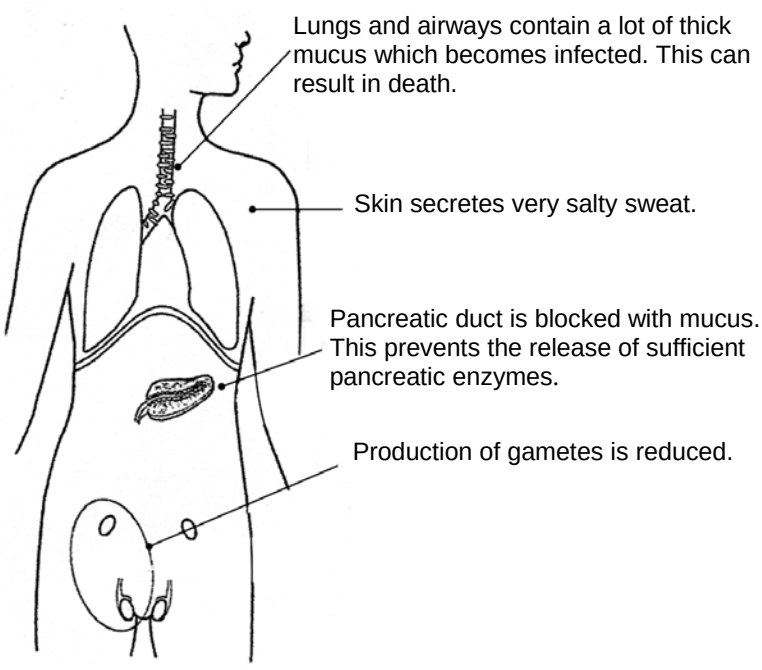
[A] Information about the cystic fibrosis mutation

Cystic fibrosis is an inherited disorder caused by a faulty gene on chromosome 7 which in turn produces a faulty protein. This results in mucous secreting glands (particularly in the lungs and pancreas) producing abnormally thick mucus.



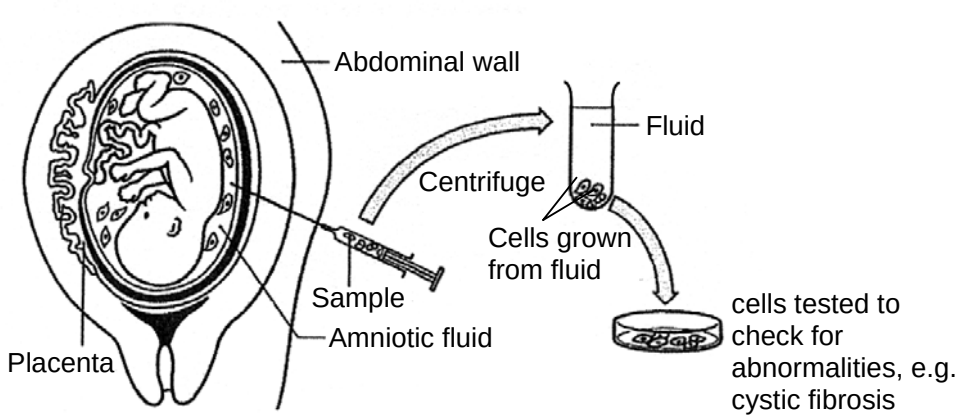
Chromosome 7

Diagram to show the effects of cystic fibrosis on the human body.



[B] Information on two methods used to check whether a foetus has any genetic abnormality.

1. **Amniocentesis**



[Adapted from *Pickering*]

A syringe is inserted through the abdominal wall of the pregnant female. Fluid containing foetal cells from the skin and digestive tract, is collected. These cells can be grown and a series of tests carried out on them to check for genetic abnormalities.
The procedure is usually offered to 'high risk' women (typically aged 38 – 40); the dangers of the procedure are outweighed by the opportunity to diagnose any foetal abnormality in the foetus. These tests are performed between 16 – 18 weeks after which the pregnancy can be terminated if necessary.

2. **Chorionic villus sampling**

A tiny sample of tissue is removed from the placenta of the mother's uterus using a special syringe and the help of a scanner.

The cells (genetically identical to the foetus) are inspected in the laboratory to see if their genetic material has any abnormalities indicating that the baby will suffer from an incurable disease such as cystic fibrosis.

If this proves to be the case, the parents can decide to have the pregnancy terminated, as early as 8 weeks into the pregnancy. However, studies have shown that CV sampling is followed by a miscarriage in about 3 out of every 100 of mothers whose babies are found to be normal.

[C] Genetic Counselling and Screening offered to prospective parents

Cells from the mother and father are collected and examined. The possibility of any chromosomal abnormalities in their future children is explained to the parents. The counsellor analyses the risks and gives the parents advice.

[D] Medication now and in the future

Presently pancreatic enzymes (needed to digest food) can be replaced (by pills). This can counteract the effect of cystic fibrosis on the activity of the pancreas. Intensive physiotherapy can help to remove the mucus from the lungs. Genetic therapy is being developed to prevent the formation of thick abnormal mucous secretions and will be tested.

[Adapted from *Human Physiology*; Davies, Blakeley and Kidd]

[E] Remember to refer back to Question 1.3.