



NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2015

LIFE SCIENCES: PAPER I

Time: 3 hours

200 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 13 pages and a yellow Answer Booklet of 12 pages (i – xii). Please check that your question paper is complete. Detach the yellow Answer Booklet from the middle of the question paper.
 2. This question paper consists of four questions.
 3. Question 1 must be answered in the yellow Answer Booklet provided. Questions 2, 3 and 4 must be answered in your Answer Book.
 4. Read the questions carefully.
 5. Number the answers exactly as the questions are numbered.
 6. Use the total marks that can be awarded for each of Questions 1, 2, 3 and 4 as an indication of the detail required.
 7. It is in your own interest to write legibly and to present your work neatly.
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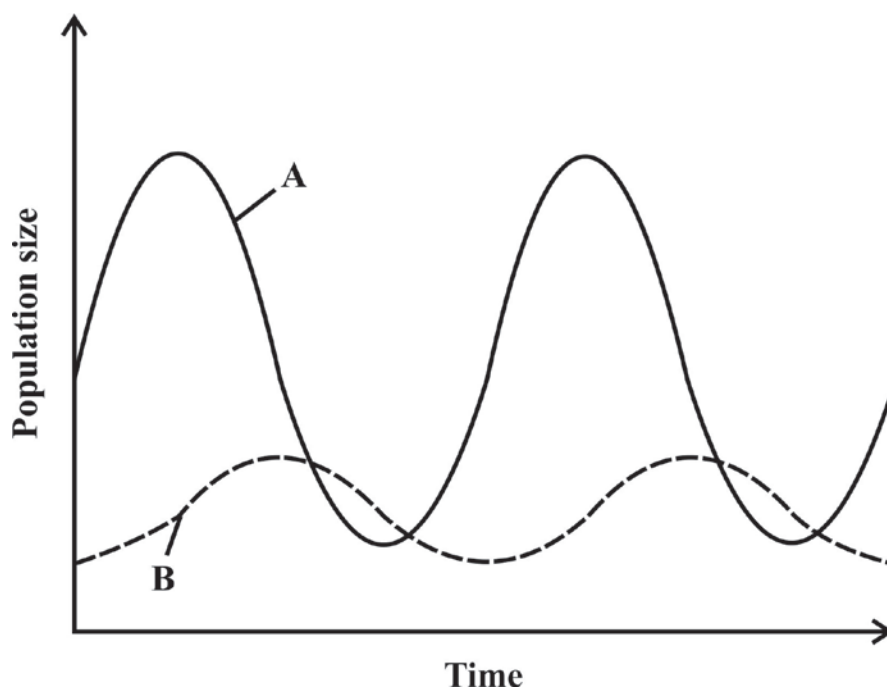
QUESTION 2

- 2.1 The African Wild Dog, *Lycaon pictus*, is one of the world's most endangered mammals. The largest populations remain in southern Africa and the southern part of East Africa. Wild dogs are some of Africa's most successful hunters, with a kill rate as high as 80%. This means they are even more successful than lions.



[Source: <<http://www.african-safari-pictures.com>>]

- 2.1.1 List **THREE** reasons why the social structure of African Wild Dog packs makes them such successful hunters. (3)
- 2.1.2 A lone, isolated animal would be easy prey for the African Wild Dog pack, but animals that live in herds are more difficult to capture. Explain **ONE** reason why this might be the case if the pack were to attempt to capture a young zebra from its herd. (2)
- 2.1.3 The graph below shows how the numbers of predators and prey fluctuate over time. Which lines (A or B) would represent the African Wild Dog population in a reserve? Give **TWO** reasons for your choice. (3)



[Adapted from: <<http://www.tiem.utk.edu>>]

2.2 Human population growth is of enormous concern. Unless we can bring it under control, the future of humans on this planet is uncertain. Four factors may affect the size of a human population. They are:

- Birth rate
- Death rate
- Emigration rate
- Immigration rate

Which of these factors would cause a population to decrease in size? (2)

2.3 Read the following article about human populations and answer the questions that follow:

Kenya: In Kenya, rapid population growth since the 1950s has put pressure on resources such as land for farming, water and health care. Use of contraception increased from 7% in 1978 to 46% in 2008, contributing to a reduction in the average number of children per mother from eight to five. However, over 10 million Kenyans still do not have enough food or have poor diets.

China: China's One Child Policy, introduced in 1979, prevented hundreds of millions of births by withdrawing benefits and imposing fines on couples who had more than one child. The policy went against traditions favouring large families and may have led to some women undergoing unwanted abortions or sterilisation and abandoning girl children. Most abortions during this time were of female foetuses.

France: France adopted a policy for the first half of the 20th century – the 'Code de la famille' – which offered strong incentives for having a three-child family. It also included a ban on contraceptives, though this was lifted in the 1960s.

[Source: <<http://bigpictureeducation.com>>]

2.3.1 Why do you think the French government introduced the 'Code de la famille'?

(2)

2.3.2 State TWO negative implications of China's policy for its future population.

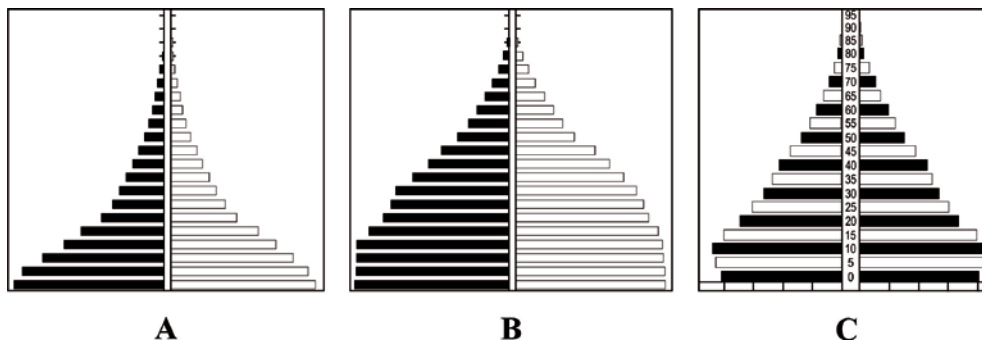
(4)

2.3.3 Explain ONE other strategy that the Chinese government could have implemented to reduce population growth.

(2)

2.3.4 Below are three possible population pyramids for Kenya. Which pyramid (A, B or C) best illustrates the situation in 2008? Explain your choice.

(3)



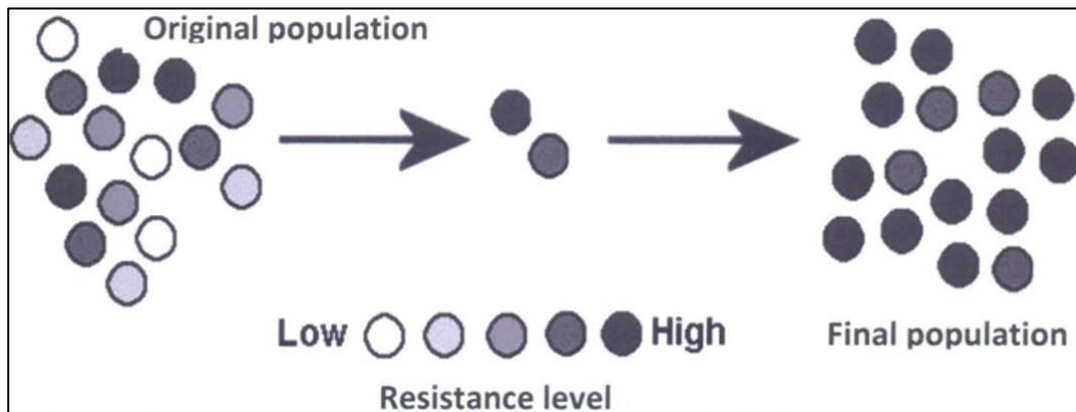
[Source: A & B <<http://geogjis-as-population.wikispaces.com>>, C – <http://www.financialtransparency.org>>]

- 2.4 The following text appeared in an issue of *New Scientist Magazine* on 11 March 2013:

Antibiotic resistance poses an 'apocalyptic' threat to human health. We are facing 'nightmare bacteria' and a 'war' against them – which we are losing. Such language, in statements from the top United Kingdom and United States medical authorities – normally a very cautious bunch – reflects the enormity of the situation they feel we are now in.

[Adapted from: <www.newscientist.com/article/n23259>]

Antibiotic-resistant bacteria evolve when antibiotics are prescribed or administered incorrectly. The following diagram illustrates this process.




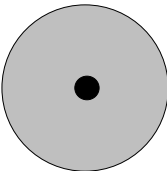
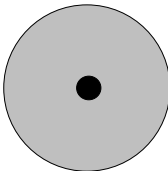
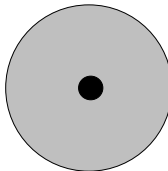
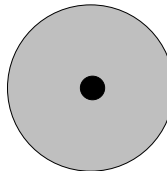
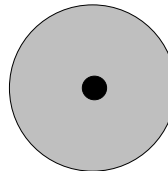
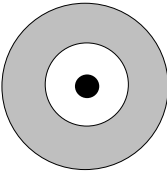
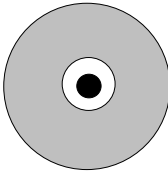
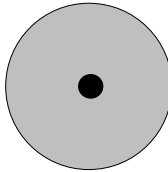
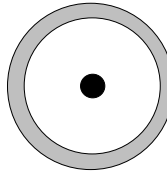
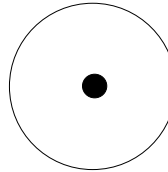


[Source: <<http://staff.jccc.net/pdecell/bio122/resistance.gif>>]

By means of a flow diagram, explain how colonies of antibiotic-resistant bacteria establish themselves when the antibiotics are not properly administered.

(5)

- 2.5 Thando and Susan are microbiology students investigating penicillin resistance in modern day bacterial cultures. Penicillin had, in the past, been an effective antibiotic and so they decided to set up an experiment to determine which type of bacterium has developed the greatest resistance to penicillin. They obtained pure cultures of five different types of bacteria (A – E) and placed each type of bacteria into a separate Petri dish with nutrient agar. Once the agar was set, a hollow was cut in the agar in the centre of each Petri dish, using a cork borer. Penicillin was then added to the hollows. After incubation at 25 °C for 24 hours, the Petri dishes were examined.

KEY					
Area with living bacteria			Area containing penicillin		
			Clear zone – no bacteria		
					
Start of experiment	Bacteria Type A	Bacteria Type B	Bacteria Type C	Bacteria Type D	Bacteria Type E
					
End of experiment	Bacteria Type A	Bacteria Type B	Bacteria Type C	Bacteria Type D	Bacteria Type E
					

- 2.5.1 State the dependent variable in this experiment. (1)
- 2.5.2 State the independent variable in this experiment. (1)
- 2.5.3 State THREE variables that Thando and Susan should have kept constant in order to make this experiment valid. (3)
- 2.5.4 Provide a suitable hypothesis for this experiment. (3)
- 2.5.5 Which bacteria showed the most antibiotic resistance? Explain how you arrived at this answer. (3)
- 2.5.6 Thando and Susan forgot to set up controls for this experiment.
- (a) Explain why controls are necessary in this experiment. (2)
- (b) Which 'ingredient' would be missing from the controls? (1)

[40]

QUESTION 3

3.1 Study the text and diagrams below and answer the questions that follow:

The prickly spines on a cactus and the leaves on an oak tree might not look the same, but in fact they are both types of leaves that have become modified for very different functions. While cactus spines can photosynthesize, they are primarily for protection and prevention of water loss in a hot and dry environment because they have a very small surface area. The oak tree leaves are larger and are used mainly for photosynthesis.

DIAGRAM OF A CACTUS

[<<http://www.3dcadbrowser.com>>]

DIAGRAM OF AN OAK TREE

[<<http://thumbs.dreamstime.com>>]

DIAGRAM OF CACTUS SPINES

[<<http://www.cactusspine.com>>]

DIAGRAM OF AN OAK LEAF

[<<http://images.clipartpanda.com>>]

- 3.1.1 Are the leaves of the oak and the spines of the cactus examples of convergent or divergent evolution? Explain your answer. (3)
- 3.1.2 How would Darwin describe the evolution of the modern day cactus leaf in an area that had undergone climate change from a mild climate to a very hot, dry environment? (7)

3.2 Study the text and table below and answer the questions that follow:

In a particular species of rat, there are three possible fur colours. This species is found in a desert area with mostly light brown sand and a few scattered plants. These rats are preyed upon by birds of prey in the area.



[Source: <<http://swegizmo.deviantart.com>>]

The table below describes the rats that live in the area in terms of various characteristics.

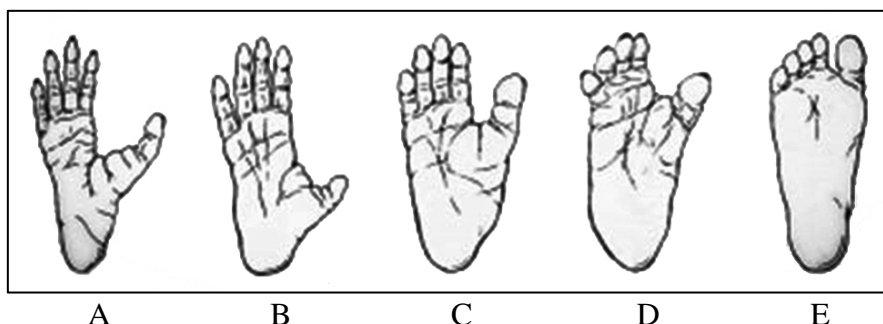
Characteristics of each female rat	Colour of Fur		
	Light Brown	Black	White
Average running speed (cm/s)	6	7	8
Total number of babies produced per female	11	5	2
Average age at death (months)	8	5	4

3.2.1 Which colour rats could be considered the 'fittest' in terms of natural selection? Explain your answer. (3)

3.2.2 Which colour rats are most likely to become extinct? (1)

3.2.3 What was the most significant threat to the survival of these rats? Explain how you arrived at your answer. (2)

3.3 The illustrations below show the under-surface of feet of various modern primates. Study the diagrams below and answer the questions that follow:



[Adapted from: <<http://www.uchicago.edu>>]

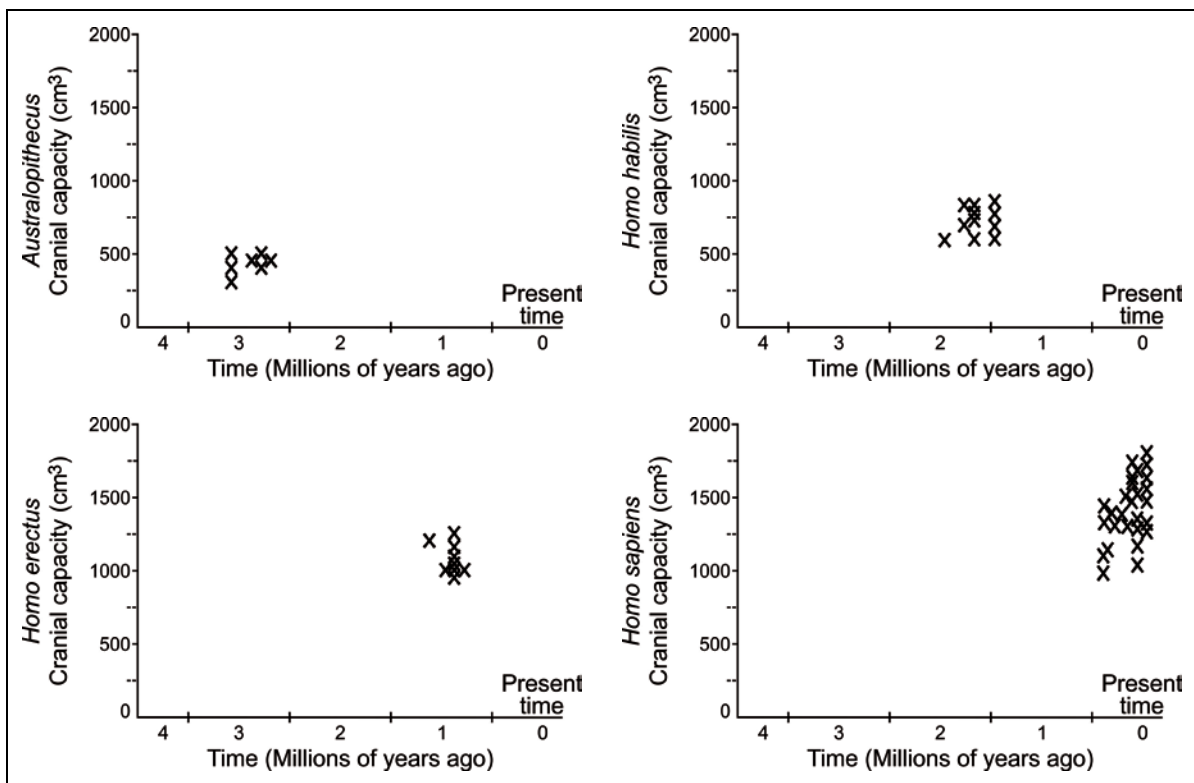
3.3.1 Which of these feet (A – E) belong to modern man? (1)

3.3.2 What TWO visible features evident in the diagrams indicate that modern man's mode of locomotion differs from that of a tree-dwelling primate? Explain your reasoning. (4)

3.3.3 Bipedal locomotion was one of the key factors that influenced the evolution of hominids. Discuss THREE aspects of life that changed for hominids when they became bipedal, and comment on the advantage that each of these aspects gave to the bipedal individuals. (6)

3.3.4 In the skulls of primates A and E, various differences would be visible. State TWO differences between these two skulls. (2)

3.4 The graphs below show some estimates of cranial capacities of *Australopithecus*, *Homo erectus*, *Homo habilis* and *Homo sapiens*. The crosses indicate fossils that have been found and studied.



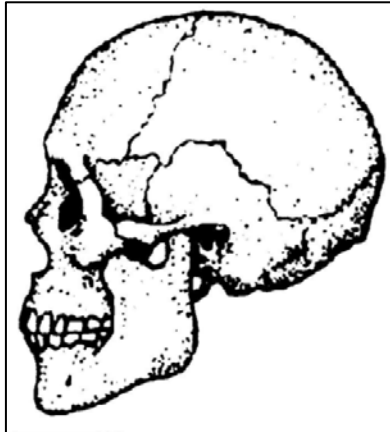
3.4.1 What is the range of estimates of cranial capacity of *Australopithecus*? (2)

3.4.2 What is the age and cranial capacity of the oldest *Homo erectus* fossil found? (2)

3.4.3 According to the graph, how long ago did *Homo sapiens* first exist? (1)

3.4.4 Draw a very simple trend graph to show how the cranial capacity has increased over time. Your axes must be labelled but no scales are required and no values need to be accurately plotted. (You must indicate present time in the same way that the graphs above do.) (3)

- 3.5 The diagram below is of a skull belonging to *Homo sapiens*. Answer the questions that follow:



[Source: <<http://www.talkorigins.org>>]

- 3.5.1 List ONE feature observable in this skull that would give this species an advantage over other hominid species. (1)
- 3.5.2 Explain the significance of the feature listed in Question 3.5.1 to the evolution of modern humans. (2)
- [40]

QUESTION 4

4.1 The following article appeared in the *Sunday Tribune* in June 2014:

Switched babies

June 1 2014 at 10:23 a.m.

By Vivian Attwood.

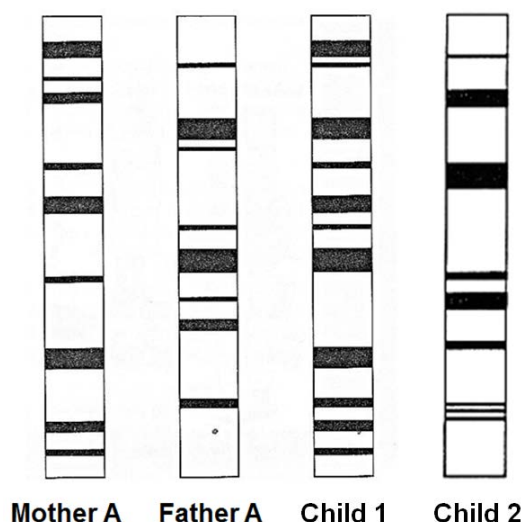
Durban – The case of two children who were mistakenly switched shortly after birth made headlines this week.

The babies, a boy and a girl, were born on the same day in 2010 at Oliver Tambo Memorial Hospital in Johannesburg. While the hospital has conceded its error, it has given no details of how it occurred. The mistake was detected when one of the mothers had DNA tests done after her ex-husband refused to pay maintenance, claiming he was not the father.

This mother then demanded that her biological child be returned to her. However, the other mother refused. The matter is currently to be considered by the North Gauteng High Court.

[Source: <www.iol.co.za/news/south-africa>]

- 4.1.1 Define the term 'DNA tests' as referenced in the text above and briefly explain the procedure involved in these tests. (3)
- 4.1.2 This matter is charged with emotion and a High Court is expected to weigh up both options and make an objective decision. Discuss ONE argument for and ONE argument against the returning of the babies to their biological families. (4)
- 4.1.3 The diagram below shows the DNA profiles of one set of parents with their biological child and the child that they took home from the hospital. Which child (1 or 2) is the biological child of Mother A and Father A? Explain your choice. (2)



[Adapted from: <<http://www.accessexcellence.org>>]

- 4.1.4 State TWO examples of how DNA profiling may be useful other than in cases of establishing biological parents. (2)

4.2 Read the following text and answer the questions that follow:

In Fabry's disease, a faulty metabolic enzyme causes the accumulation of a specific glycolipid. The full-blown disease occurs mainly in males because the defective gene for this rare disorder is carried on the X chromosome. The accumulation of this glycolipid causes the following symptoms:

- noncancerous (benign) skin growths form on the lower part of the body.
- the corneas become cloudy, resulting in poor vision.
- children with Fabry's disease eventually develop kidney failure and heart disease, but most live to adulthood.
- high blood pressure, which may result in stroke.

Fabry's disease can be diagnosed in the foetus by chorionic villus sampling or amniocentesis. The disease cannot be cured or even treated directly, but researchers are investigating a treatment in which the deficient enzyme is replaced by transfusion.

[Adapted from: <<http://www.merckmanuals.com>>]

- 4.2.1 Where in the genome does the gene coding for the deficient enzyme, which results in Fabry's disease, occur? (1)
- 4.2.2 This disease is caused by a recessive gene mutation. Explain this statement using TWO pieces of evidence from the text to support your answer. (4)
- 4.2.3 Name a different sex-linked disorder that you have studied and explain how this disorder would affect the sufferer. (2)
- 4.2.4 Michael has Fabry's disease. He marries Jennifer who has **no history** of Fabry's disease in her family. Before they decide to have children, they visit a genetic counsellor to determine the chances that their offspring will suffer from the disease. Before she starts, the genetic counsellor tests Jennifer and confirms that she does not carry the mutation in question.
- (a) Using the letter N for the normal gene and n for the gene for Fabry's disease, draw a **full genetic cross** to show the probabilities of their children inheriting the gene. Your genetic diagram must include: (7)
- the parental genotypes
 - a genetic cross
 - the ratio of the possible genotypes and phenotypes for the offspring
- (b) Michael's sister Vanessa fell pregnant and discovered that her foetus was a boy with Fabry's disease. She decided to abort the foetus. Do you agree with Vanessa's decision? Explain giving TWO reasons to support your answer. (2)

4.3 Read the following text and answer the questions that follow:

Text A

Marula trees are indigenous to southern Africa. The fruit of the Marula tree is round and fleshy and when ripe, it is used to make jams, jellies, juices and alcoholic drinks. Even the peel can be used for a variety of homeopathic remedies and aromatherapy. Because of its usefulness to man, the hunter-gatherers of old used to pick the tastiest fruits and plant them around their camps so they would have a continual supply of tasty fruit each season. Each year, the seeds from the largest fruits would be chosen from these trees and the process would be repeated.



The Marula Fruit

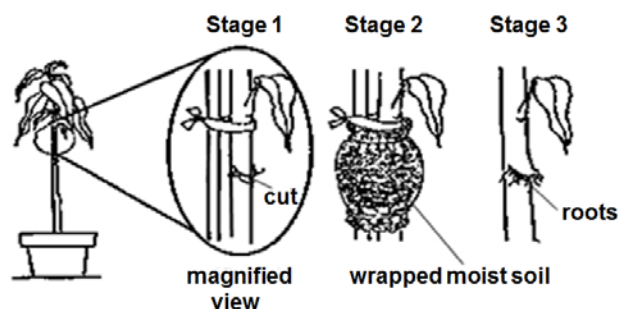
[Source: <<http://ccms.distell.co.za>>]

4.3.1 Explain why only the seeds from the largest fruits were selected and planted each season. (2)

4.3.2 Read the following text and answer the questions that follow:

Text B

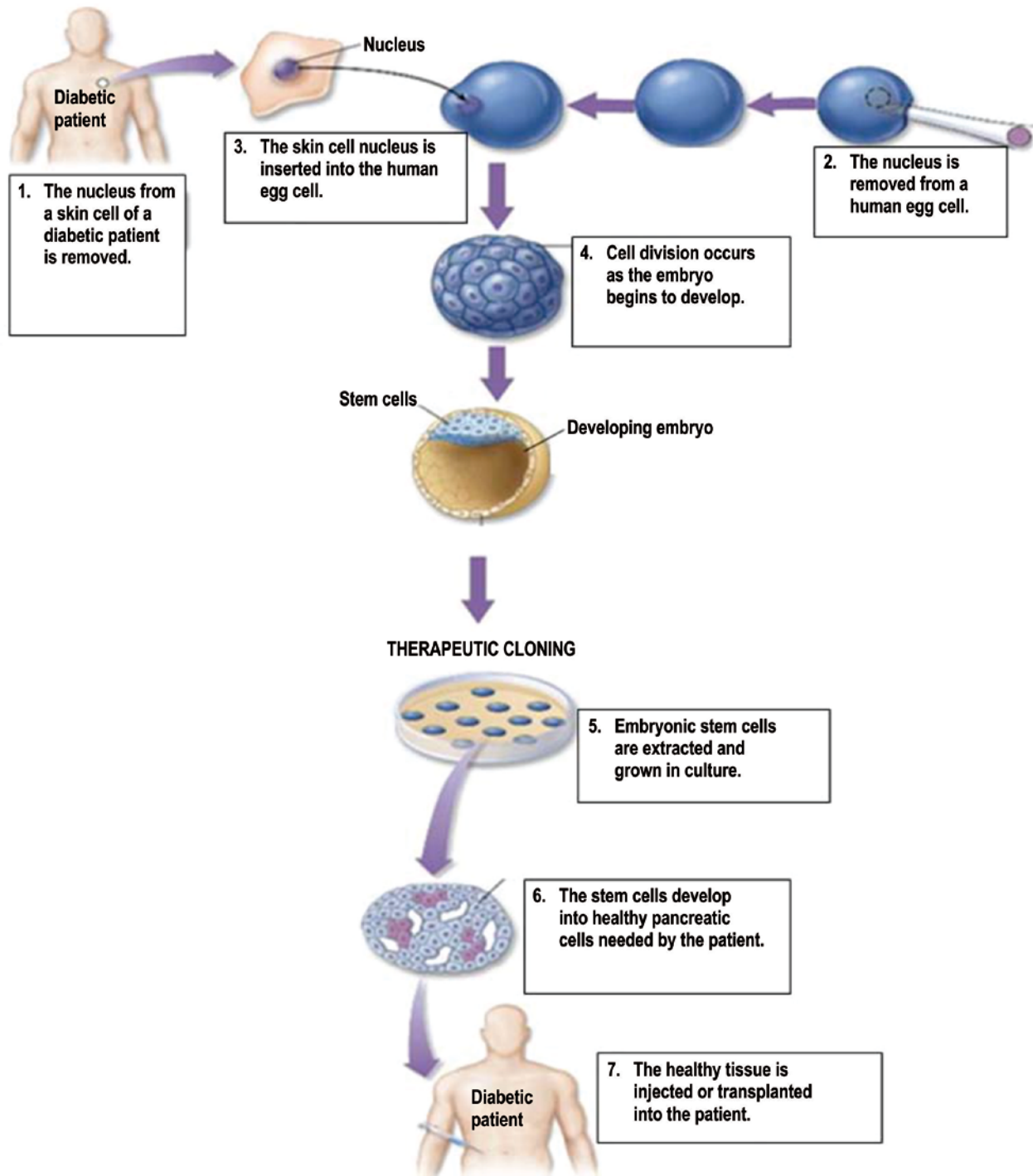
A current agricultural practice with the Marula tree is one known as 'marcotting'. This involves peeling a section of bark from a branch of a living Marula tree. This 'naked' section is wrapped with soil and it then starts to produce roots. The branch with the roots is then cut off and planted in the soil where it grows into a new tree.



[Source: <<http://oldschool.com>>]

- (a) What can you conclude about the genotype of the new tree which is propagated in this way? (2)
- (b) Describe ONE advantage and ONE disadvantage of a plantation of Marula trees grown using the technique described in Text B above compared to a population of Marula trees planted from seed. (2)
- (c) Should the fruit from the marcotted Marula tree be referred to as 'genetically engineered'? Explain your answer. (2)

- 4.4 A very exciting new treatment which is currently being developed to treat Type 1 Diabetes involves the use of a procedure known as 'Therapeutic cloning'. This procedure is outlined in the diagram below:



[Adapted from: <<http://bio1100.nicerweb.com>>]

- 4.4.1 Suggest why a skin cell nucleus is used rather than a pancreatic cell from the patient. (2)
- 4.4.2 What is the advantage of using cells cloned from a person's own stem cells to treat Type I Diabetes? (1)
- 4.4.3 If this procedure is successful, what would the desired outcome be? (2)
- [40]**

Total: 200 marks