NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2020

AGRICULTURAL SCIENCES

Time: 3 hours 300 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 20 pages and an Answer Sheet of 2 pages (i–ii). Please check that your question paper is complete. Detach the Answer Sheet from the centre of the question paper and ensure that it is handed in together with the Answer Book.

2. This question paper consists of **THREE** sections, namely **SECTION A**, **B** and **C** that, together, have six questions.

3. Question 1 must be answered on the Answer Sheet provided. Questions 2–6 must be answered in your Answer Book.

4. Read the questions carefully.

5. Start **EACH** question on a **NEW** page.

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

7. Use the marks awarded for each question as an indication of the detail required.

8. Non-programmable calculators may be used.

9. Show all your calculations, including formula and units, where applicable.

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

SECTION A

QUESTION 1

1.1 Give the correct term for each of the following descriptions. Write only the term next to the question number (1.1.1–1.1.6) on the attached ANSWER SHEET.

1.1.1 A pest-control programme in which different methods of control work together to optimise pest control.

1.1.2 The production of fruit without the fertilisation of ovules.

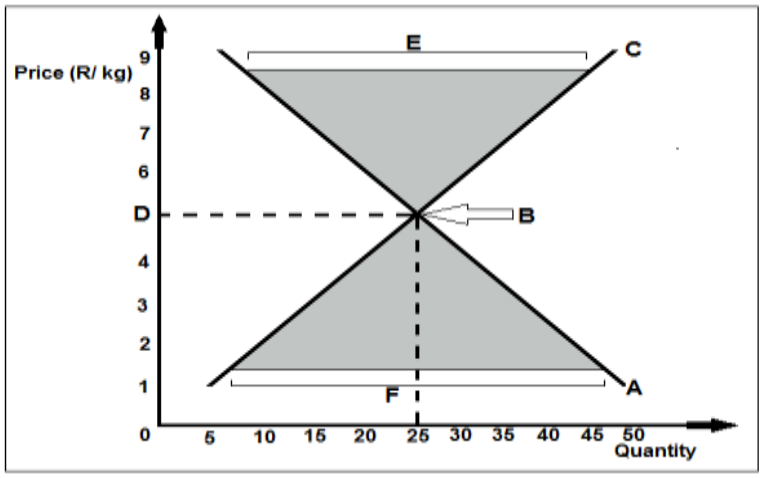
1.1.3 The loss or decline in value of movable assets such as vehicles and machinery due to wear and tear.

1.1.4 The type of labourers who have no formal skills or training and gain experience as they do their work over many years.

1.1.5 The spontaneous changes in the DNA structure forced by exposure to certain chemicals and resulting in unique new individuals.

1.1.6 A pattern of inheritance in which both alleles are expressed fully in the heterozygous individuals. (12)

1.2 Identify the letter below that represents each of the following parts of the graph. Write only the correct letter (**A–F**) next to the question number (1.2.1–1.2.6) on the attached ANSWER SHEET.



1.2.1 The curve representing the quantity of goods offered for sale at a particular period.

1.2.2 An area representing surplus of the product in the market.

1.2.3 Market clearing price.

1.2.4 The curve showing the amount consumers are willing to buy at a given price.

1.2.5 An area representing shortage of the product in the market.

1.2.6 The market equilibrium point. (12)

1.3 In the table below, a description and TWO possible answers are given. Indicate whether the description in COLUMN B relates to **A only**, **B only**, **Both A and B** or **None** of the answers in COLUMN A. Make a cross (X) in the appropriate block next to the question number (1.3.1–1.3.6) on the attached ANSWER SHEET.

EXAMPLE

	COLUMN A	COLUMN B
1.3.7	A Heartwater B Red water	A disease transmitted by a blue tick.

ANSWER

1.3.7	**A only**	~~**B only**~~	**A and B**	**none**

	COLUMN A	COLUMN B
1.3.1	A Protozoan B Fungal	These micro-organisms cause diseases such as rabies and foot-and-mouth disease (FMD).
1.3.2	A Biometrics B Biosecurity	The study of measurable biological characteristics by using computer technology.
1.3.3	A Parturition B Gestation	The animal reproduction period from fertilisation to birth, during which the foetus develops inside the mother.
1.3.4	A Green markets B Ecolabelling	Sustainable agricultural marketing involves adoption of practices that are environment-friendly and reduce carbon footprints.
1.3.5	A Species crossing B Out crossing	Repeated mating of pure-bred male animals with inferior female animals, generation after generation.
1.3.6	A Pulse rate B Respiratory rate	It is equal to the number of heartbeats in a full minute.

(12)

1.4 Change the UNDERLINED WORD(S) in each of the following statements to make the statements TRUE. Write only the correct word(s) next to the question number (1.4.1–1.4.6) on the attached ANSWER SHEET.

1.4.1 Soil inspection is the methodical examination, classification and description of soil by the physical examination of a soil profile.

1.4.2 Epididymis is a tube of muscular tissue and is the common canal for the excretion of urine and semen in bulls.

1.4.3 Epistasis is the reappearance of an ancestral trait after it has apparently not come to light for a few generations.

1.4.4 Prolactin is the hormone responsible for stimulation of milk ejection by encouraging the contraction of myoepithelial cells.

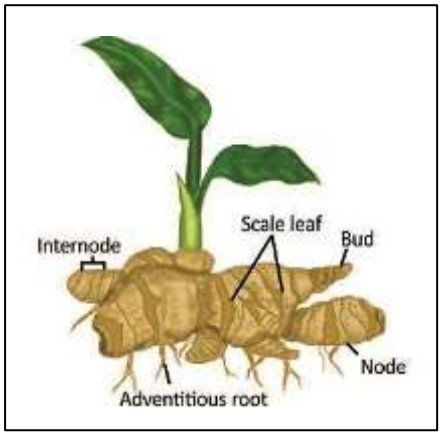
1.4.5 Diseases that can be transmitted from animals to humans and from humans to animals are called metabolic.

1.4.6 The planting of the same crop over consecutive seasons in the same area is known as crop rotation. (12)

1.5 Various options are provided as possible answers to the following questions. Choose the correct answer and make a cross (X) in the block (A to D) next to the question number (1.5.1 to 1.5.10) on the attached ANSWER SHEET. NO marks will be awarded if more than one cross (X) appears for the answer.

EXAMPLE	1.1.1	X	B	C	D

1.5.1 The diagram of the plant below is an example of a ...

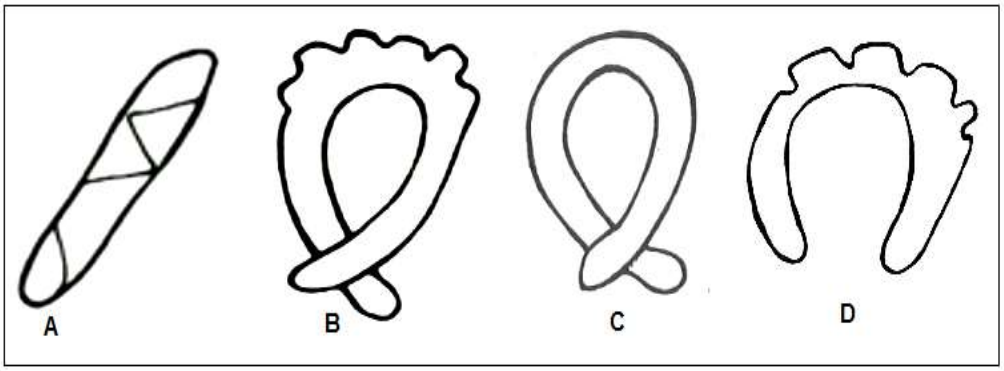


A bulb.
B rhizome.
C corm.
D runner.

1.5.2 A period of resting when the seed will not germinate even if the environmental conditions are good is called …

A pollination.
B hibernation.
C dormancy.
D fumigation.

1.5.3 Soil texture can be determined by using the 'field method'. Identify from the texture diagrams below the one that characterises pure clayey soil.



1.5.4 Soil scientists follow a certain procedure to identify and classify soil using a binomial system. The step after the major horizon has been demarcated involves ...

A determining soil series.
B identifying diagnostic horizon.
C establishing soil form.
D determining series characteristics.

1.5.5 The following applies to Newcastle disease:

(i) It is a viral disease.
(ii) It affects poultry of all ages.
(iii) It is a bacterial disease.
(iv) No treatment for infected animals.

Choose the CORRECT combination:

A (i), (ii) and (iv)
B (i), (iii) and (iv)
C (ii), (iii) and (iv)
D (i), (ii) and (iii)

1.5.6 The foetus is surrounded by three layers while attached to the uterus. What is the correct sequence of the layers from the inner to the outer layer?

A Allantois, chorion and amnion
B Amnion, allantois and chorion
C Chorion, amnion and allantois
D Amnion, chorion and allantois

1.5.7 The following are some of the characteristics of external parasites:

(i) They damage the skin of the host animal.
(ii) Roundworms and tape worms are good examples.
(iii) They lower the production of the host animal.
(iv) They transfer diseases to the host animal.

Choose the CORRECT combination:

A (i), (ii) and (iv)
B (ii), (iii) and (iv)
C (i), (ii) and (iii)
D (i), (iii) and (iv)

1.5.8 Which ONE of the following items is an example of floating capital?

A Vehicles
B Buildings
C Seed
D Irrigation system

1.5.9 The factors that cause a shift in the demand curve are …

(i) consumer income.
(ii) changes in the prices of related goods.
(iii) consumers' tastes and preferences.
(iv) industry growth and shrinkage.

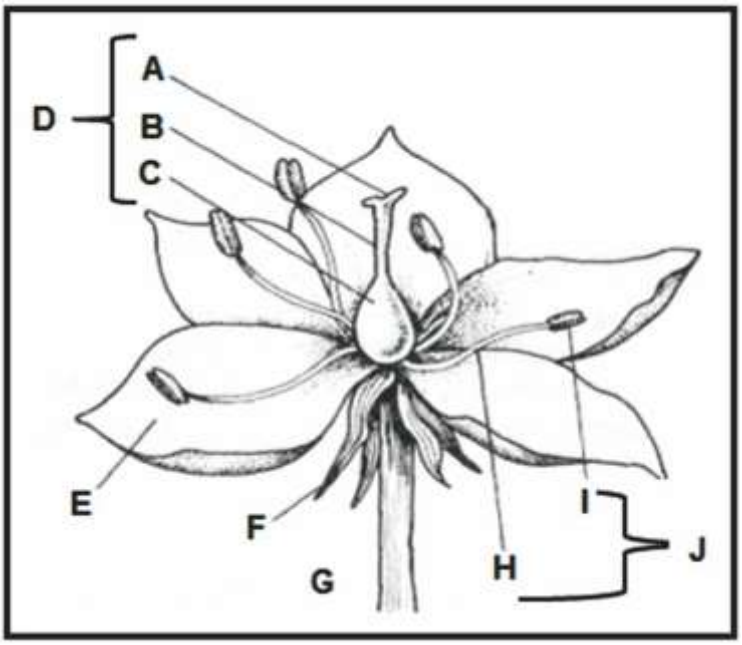
Choose the CORRECT combination:

A (i), (ii) and (iv)
B (i), (iii) and (iv)
C (ii), (iii) and (iv)
D (i), (ii) and (iii)

1.5.10 A single-comb cock with a genotype represented by **Dd** is crossed with a pea-comb hen with a genotype represented by **dd**. Their offspring will have the following phenotypic ratio:

A 50% single-comb and 50% pea-comb
B All single-comb
C All pea-comb
D 75% single-comb (20)

1.6 Match the functions listed below with the part of the flower performing the function. Write the correct letter (A to J) and the name of the part next to the question number (1.6.1 to 1.6.6) on the attached ANSWER SHEET.



1.6.1 Production of pollen grains.

1.6.2 Attracts insects and birds to the flower for easy pollination.

1.6.3 Serves as a female reproductive part of the flower.

1.6.4 Connecting the stigma to the ovary.

1.6.5 Production of ovules with the egg cells.

1.6.6 It is the outer tip that serves as a platform for pollen to fall on during pollination. (12)

80 marks

SECTION B

Answer Questions 2–6 in your Answer Book.

QUESTION 2

2.1 Read the following extract on rabies.

Animal health: Rabies

Rabies affects the brain, leading to acute inflammation and invariably killing the animal or person involved. Rabies is an acute fatal disease that is notifiable. It is an endemic disease in South Africa and the mortality rate is up to 100%. The disease affects the animal's central nervous system causing brain alteration and death. Every year the disease causes about 55 000 deaths worldwide, according to the World Health Organisation. More than 95% of these occur in Asia and Africa. Rabies is present in more than 150 countries and all continents except Antarctica. There is no treatment once the symptoms appear. Vaccination is the only protection. Infected animals must be destroyed and the carcasses burnt. The following table indicates the number of reported rabies outbreaks per province in South Africa.

Province	Number of reported cases of rabies in 2017	Reported cases of rabies as a percentage (%) in 2017	Number of reported cases of rabies in 2018
Eastern Cape	12	14	6
Free State	9	10	3
Gauteng	5	6	2
KwaZulu Natal	20	23	10
Western Cape	3	3	2
Northern Cape	6	7	3
Limpopo	17	20	8
Mpumalanga	10	12	5
North West	4	5	2

[Extracted from Directorate Veterinary Services, Department of Agriculture, Rabies Fact Sheet No. 99; World Health Organisation Merck Veterinary Manual]

2.1.1 Name the pathogen that causes rabies. (1)

2.1.2 Rabies is an acute fatal disease that is notifiable. It is an endemic disease in South Africa. Explain the following phrases:

(a) Acute disease (2)

(b) Notifiable disease (2)

(c) Endemic disease (2)

2.1.3 Draw a bar graph representing the percentages of reported rabies cases during 2017 per province in South Africa. (7)

2.1.4 Explain the trend in reported rabies cases that can be inferred from the data in the table. (2)

2.1.5 Indicate TWO possible reasons for the trend observed in Question 2.1.4. (2)

2.2 Biosecurity is a very important component for livestock farmers.

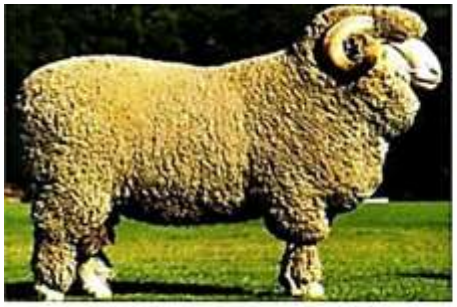
2.2.1 Define the term *biosecurity*. (2)

2.2.2 Explain FIVE measures that should be included in the farmer's biosecurity plan. (10)

2.3 The scenario below is about breeding merino sheep.

The finest merinos in SA bred using genetic extremes

Merino stud in Eastern Cape has been at the forefront of genetic fine wool production in South Africa for over a century. They are seeking to breed a sheep with specific characteristics. One of these features is a sheep that does not have horns at all (polled).



Horned merino ram

Polled merino ewe

In an attempt to achieve this outcome by selection, a polled ram and ewe from the same parents are taken and allowed to breed. Over a certain period, the ewe delivers three polled lambs and one with horns.

2.3.1 Provide the expected genotype of the ram and the ewe (Let P and p represent the dominant and recessive genes respectively). (2)

2.3.2 Would the lambs be regarded as F1 or F2 generation? (2)

2.3.3 Motivate the answer for Question 2.3.2 in reference to Gregor Mendel's fundamentals. (2)

2.3.4 Give the expected phenotype of the ram. (2)

2.3.5 Assume that the above lamb with horns was a male and the other three were all ewes.

(a) Use the Punnet square to show the possible pairings and their offspring's genotypes. (6)

(b) Indicate the percentile composition of the offspring. (2)

2.4 Indicate the pattern of inheritance that leads to different phenotypes listed below:

2.4.1 Mechanism where a genetic trait is controlled by many pairs of genes instead of only a single pair of genes. (2)

2.4.2 Both alleles are expressed as a mixture of the phenotypical characteristics of the two parents in the offspring. (2)

[50]

QUESTION 3

3.1 Read the following case study and then answer the questions.

He's only 19, but already a successful livestock farmer

"Farming is in me, it runs in my blood and veins, I am a farmer by birth," declares Thabo Dithakgwe (19 years old), one of South Africa's youngest farmers, confidently. He became a farmer at the age of 13 when his father gifted him a pregnant heifer. "When the heifer gave birth, he nurtured the bull calf until 2017 when he sold it to another farmer at a reasonable price," he says. In 2015, at the age of fourteen he received his identification certificate from the Department of Agriculture to become a commercial farmer. The young farmer owns 790 hectares of land in Pomfret, North West, a desert town on the edge of the Kalahari Desert. His family used to farm on communal land, but when he received the land, his life changed forever. He seriously started his business on this land with four permanent workers and now he achieves a 98% calving rate. With love, the right mindset and the support of his family, Thabo is doing very well in his business.

[Adapted from Mzansi for food entrepreneurial magazine of the 3rd of January 2019]

3.1.1 Would you say Thabo is an entrepreneur? (1)

3.1.2 Justify your answer to Question 3.1.1. (2)

3.1.3 Identify THREE entrepreneurial success factors for Thabo and motivate for each based on the case study. (6)

3.1.4 Identify phrases from the case study that relate to the FOUR agricultural production factors. (8)

3.2 Read the passage below on animal reproduction.

Oestrus

Oestrus is a brief period of intensive sexual activity and the only time the female will allow mating. Oestrus is caused by hormones of the hypophysis and ovaries.

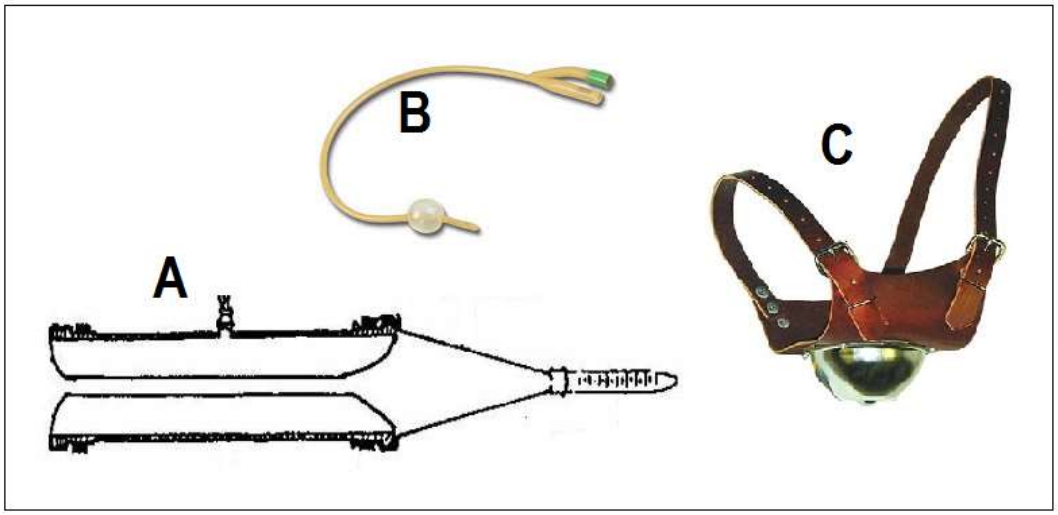
Phases of the oestrus cycle

The oestrus cycle is the rhythmical change and regular periods of oestrus that a normal, mature and non-pregnant cow displays. It starts at puberty and is repeated every 21 days unless it is interrupted by pregnancy, diseases or other factors and extends up to the end of the lifetime of a healthy cow.

3.2.1 Indicate the FOUR phases of the oestrus cycle. (4)

3.2.2 Name THREE signs that are visible in a cow in oestrus. (3)

3.3 The pictures below show equipment used in the animal reproduction industry to perform various management operations on the farm.



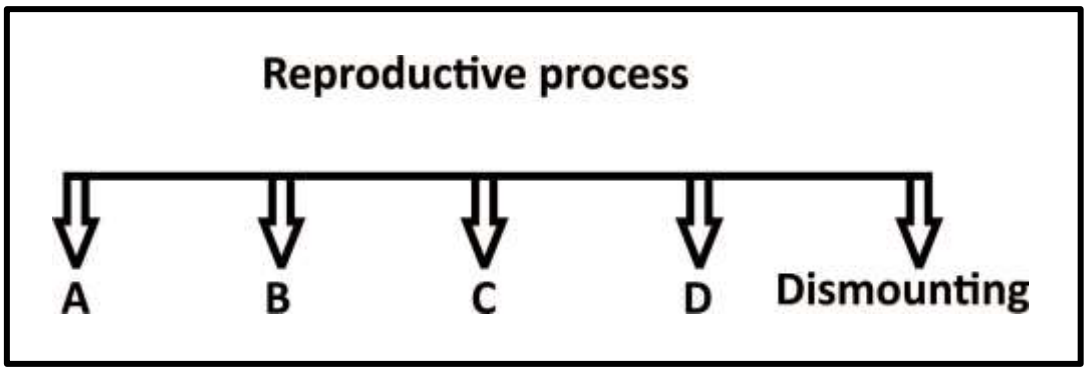
Identify the letter of the equipment that can be used for each of the functions below:

3.3.1 Assists the farmer in identifying a cow on heat. (2)

3.3.2 To recover the embryo from the uterus of the donor. (2)

3.3.3 To collect semen from the bull. (2)

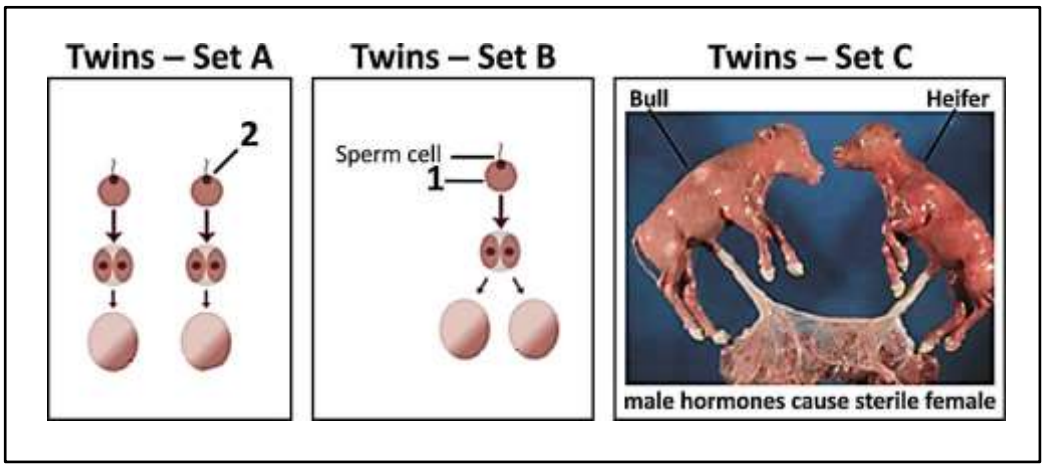
3.4 The illustration below shows a reproductive process between male and female animals in its chronological order.



3.4.1 Identify the reproductive process illustrated in the schematic representation above. (2)

3.4.2 Supply the names given to stages **A**, **B, C** and **D** in the correct order. (4)

3.5 Analyse the following illustrations and pictures and answer the questions that follow.



3.5.1 Name the types of multi births (**A**, **B** and **C**) illustrated in the pictures above. (6)

3.5.2 Identify the part labelled 1 on the twin set B above. (1)

3.5.3 Suggest the name of the process indicated by 2 on twin set A above. (1)

3.6 An organism that has superior heritable traits is replicated to produce offspring that are genetically identical to the original organism. Below are the steps involved in this process:

- The cell is artificially activated to start dividing until it turns to a blastocyst.
- The egg is treated and cultured in the laboratory to allow fusion with the nucleus.
- Transplantation into the recipient animal occurs in order to get replicas of the donor.
- Collection of somatic cells from the animal to be cloned.
- Nucleus that contains the DNA of the donor animal is removed from an egg and placed into the somatic cell.

3.6.1 Indicate the name of the breeding technique above. (1)

3.6.2 Re-arrange the steps above in chronological order to ensure that the process is carried out with success. (5)

[50]

QUESTION 4

4.1 Read the following passage and then answer the questions that follow.

Citrus farming in South Africa

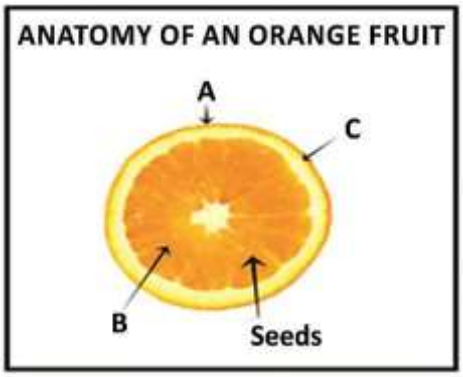
Citrus is a collective term for a genus of flowering trees and shrubs in the rue family, Rutaceae. Citrus plants produce important fruit crops such as oranges, mandarins, lemons, limes and grapefruit. Citrus fruit is produced on evergreen trees. Trees produce blossoms in spring and the fruit develops through spring and summer, ripening for harvest in late autumn and early winter. Citrus fruit is segmented and has a thick skin. All citrus fruits contain citric acid and ascorbic acid, better known as Vitamin C. Fruits are edible products of a tree or other plant that contains seed and can be eaten as food.

The cultivation of fruits differs considerably in different places owing to the physical properties of land, climate, rainfall, temperature, sunlight, cultural practices of the inhabitants, etc. The different climatic conditions in South Africa allow production of various fruits that include citrus, deciduous and subtropical fruit. The fruit industry employs both sexual and asexual reproduction methods to produce more orchards. Pollination plays a key role in promoting sexual reproduction while different methods of asexual reproduction are used to propagate fruit trees. Citrus is mainly produced in the irrigation areas of the Limpopo, Eastern Cape, Western Cape, Mpumalanga, KwaZulu-Natal and the Northern Cape. South Africa is globally known for being a net exporter of citrus, deciduous and subtropical fruits. Around 2,7 million tons, worth R26 billion, are exported to more than 90 countries. Fresh fruit makes up about 35% of agricultural exports. Other fruit is supplied to the local market, traded at wholesalers, formal municipal and metropolitan markets; supplied to processing plants for production of fruit concentrate, fruit juices and canned fruit; processed into dried fruit for both local and export markets.

[Extracted from Fruit Farming South Africa: Citrus website]

4.1.1 Name FOUR different types of fruit categorised according to the way they develop and give ONE example for each. (8)

4.1.2 The fertilised flower gives rise to seeds and fruit.



(a) Provide labels for **A**, **B** and **C** on the orange fruit diagram above. (3)

(b) Name the part of flower that develops into a fruit. (1)

4.1.3 A farmer sells oranges in different sizes to suit the preferences of consumers.

The table below shows how oranges are placed in boxes after harvesting.

SIZE AND APPEARANCE OF ORANGES	CLASS	SIZE OF THE BOX (in mm)	NUMBER OF ORANGES PER BOX
Big, ripe, smooth, no bruises	First	600 × 800	18
Medium, some not ripe, with few bruises	Second	600 × 800	24
Small, ripe, mostly bruised	Third	600 × 800	30

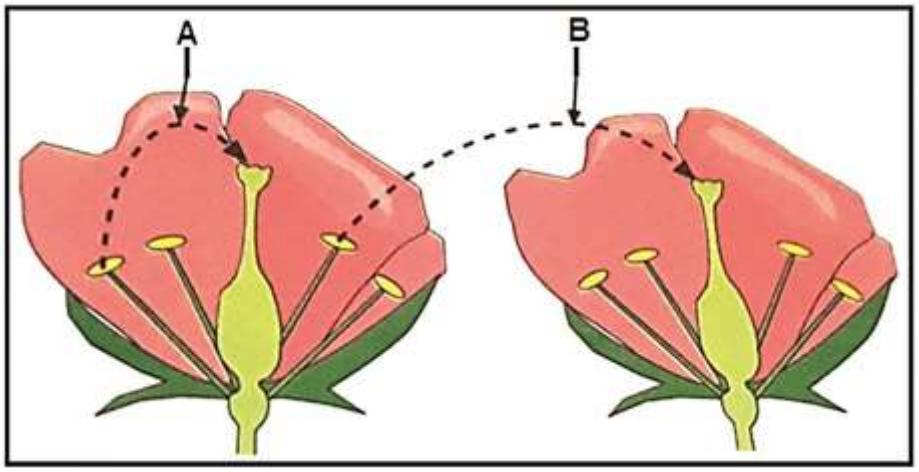
(a) Name the marketing function referred to in the table above. (1)

(b) State TWO factors used in the grading of the oranges. (2)

(c) Indicate THREE factors that could hamper the marketing of the oranges. (3)

(d) Briefly describe THREE advantages of processing oranges. (3)

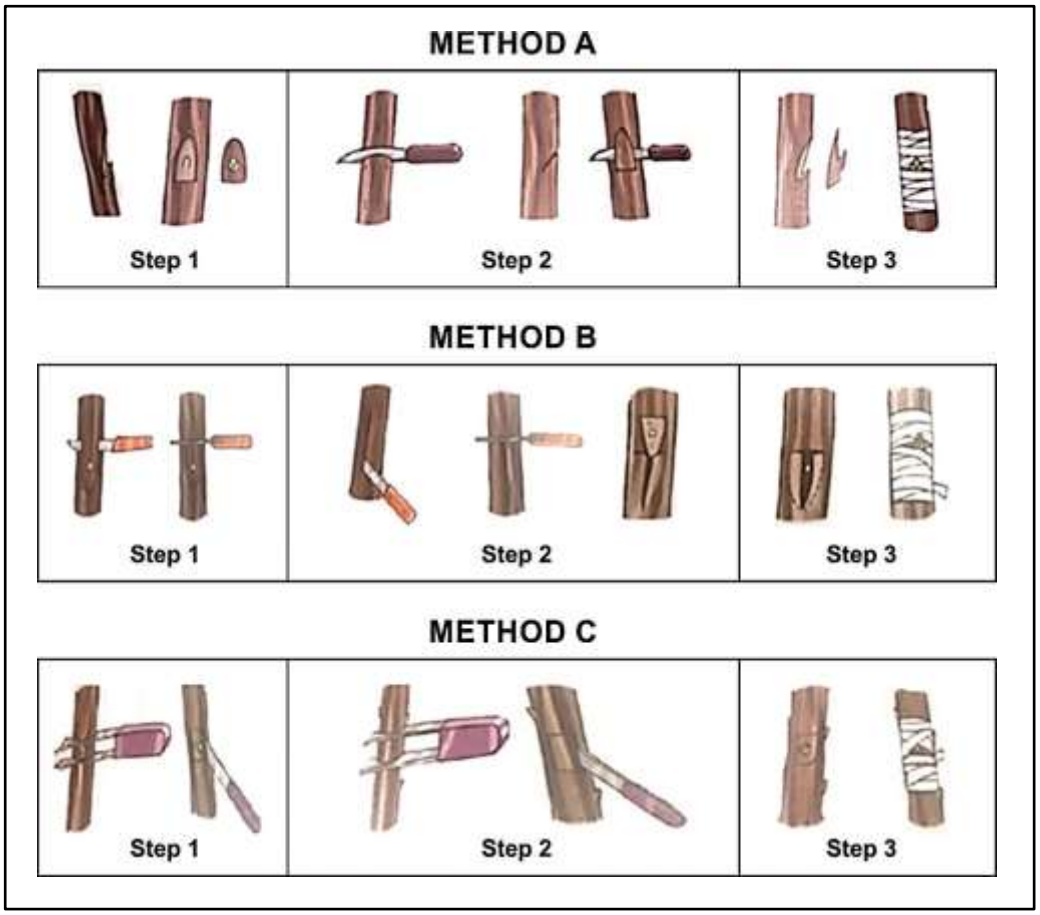
4.1.4 Pollination is the passing of pollen grains from the anther of a stamen to a stigma.



(a) Identify the TWO types of pollination depicted in the diagram (A and B) above. (2)

(b) Differentiate between the TWO types of pollination identified in Question 4.1.4 (a). (4)

4.2 Study the diagram below of an asexual reproduction technique used by citrus farmers.



4.2.1 Identify the artificial propagation technique used in the diagram above. (2)

4.2.2 Name the methods **A**, **B** and **C** shown in the diagram above. (3)

4.2.3 Identify the THREE steps involved in each method in the diagram above. (3)

4.2.4 Tabulate TWO advantages and disadvantages of using asexual reproduction in citrus fruit farming. (4)

4.3 Citrus fruit farming requires intensive labour for increased production. Labour is a combination of human energy and mental skill which together gives the farm workers the ability to do work.

4.3.1 Identify the different types of labourers described below:

(a) Workers who work less than 24 hours a month, and do not have a contract with the farmer.

(b) Workers who are employed during planting of harvesting periods.

(c) Workers who work ordinary hours set for the farming sector in the Basic Conditions of Employment Act. (3)

4.3.2 HIV and the AIDS pandemic highly affect farm labour and as a result impacts negatively on farm productivity.

(a) Explain how HIV and the AIDS pandemic impact on farm productivity. (4)

(b) How can farmers limit the impact of HIV and AIDS on productivity? (4)

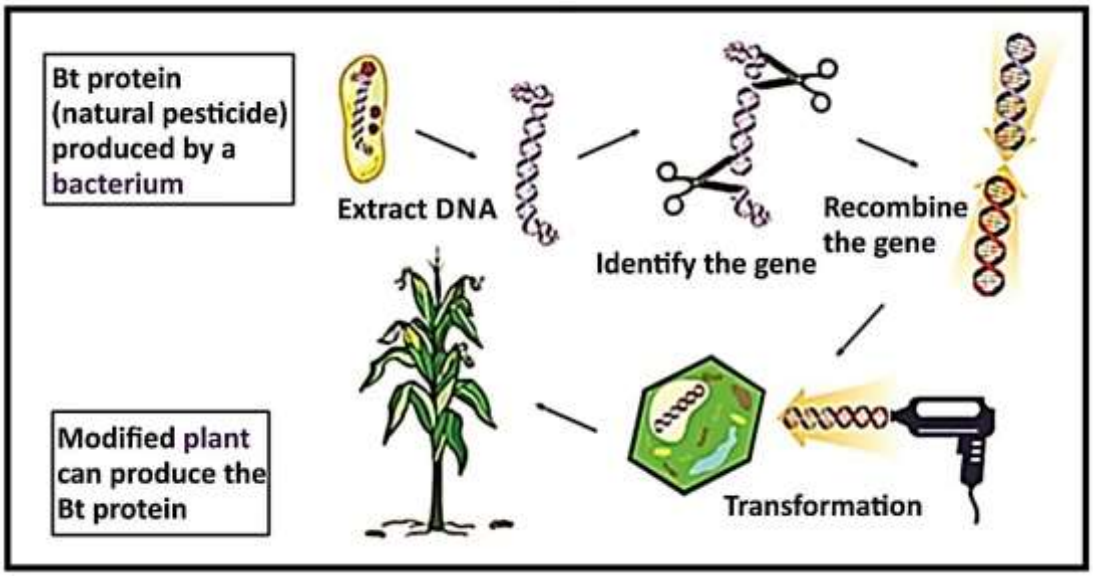
[50]

QUESTION 5

5.1

Precision agriculture is a newly coined phrase used to describe modern methods of farming management. Science has evolved drastically since the early scientists' discoveries. Genetic engineering, which is the direct human manipulation of an organism's genome using modern DNA technology, is one of these discoveries. The two biggest uses of genetic modification have been to create crops that resist the herbicide glyphosate (used to control weeds) and crops that generate their own internal insecticide (Bt, widely used by both organic and conventional growers). Both of these traits are popular with farmers, and the vast majority of corn, soya and cotton grown in the United States has one or both of them.

[Source: <www.washingtonpost.com>]



5.1.1 Evaluate the diagram above to identify the technique used to produce the modified Bt maize plant. (2)

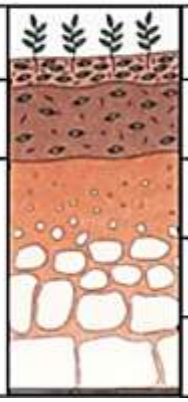
5.1.2 Discuss THREE potential environmental hazards of genetic modification in South Africa. (6)

5.1.3 Suggest TWO reasons for modifying animals genetically. (2)

5.1.4 Define *precision farming*. (2)

5.1.5 Explain THREE main aims of precision farming. (6)

5.2 Soil classification is a systematic way of grouping soils into classes according to certain characteristics. Soils are generally classified according to morphological, physical, chemical and mineralogical characteristics.

MASTER SOIL HORIZONS			
1		3	Fresh and partly decomposed organic matter
2		4	Consists of humus and mineral particles
Substrata		5	Concentration of clay and iron, aluminium or manganese oxides
		6	Soft consolidated material and weathered rocks
		R	R-horizon consists of solid rocks

5.2.1 Indicate the labels for parts 1 to 6 of the master soil horizons above. (6)

5.2.2 Supply THREE reasons for the farmers to classify soil on the farm. (6)

5.3 An emerging livestock farmer drew up an estimated *income and expenditure plan* for the farm enterprise. The farmer borrowed start-up capital from the bank as a loan and used his house as collateral. The estimated plan included the following transactions:

- Sale of sheep R77 500
- Wages of farm workers R22 400
- Repayment of loans and overdraft R13 700
- Interest from savings R1 800
- Feed and medication R15 000
- Sale of wool R8 900

5.3.1 Draw up a complete income statement for the farm using the information provided in Question 5.3 above. (8)

5.3.2 Calculate the farmer's expected profit or loss using the information provided in Question 5.3 above. (3)

5.3.3 Define the following terms:

(a) Overdraft (2)

(b) Collateral (2)

5.4 Match the marketing channels listed in the box to the descriptions below.

Internet marketing; Fresh-produce markets; Stock sales; Contract market; Farm-gate marketing

5.4.1 Goats, sheep and cattle are sold on auction to the highest bidder. (1)

5.4.2 Goods are advertised and sold electronically, mostly by using computers. (1)

5.4.3 An agreement or arrangement by the farmer to sell direct to the wholesaler. (1)

5.4.4 A farmer sells cabbage direct from the farm. (1)

5.4.5 Mangoes and apples are graded, weighed and the whole lot is purchased and delivered immediately to markets. (1)

[50]

200 marks

SECTION C

QUESTION 6

Read the passage below about soil conservation and erosion and then answer the questions that follow.

> Most cattle farmers are of the opinion that they are first and foremost grass farmers as opposed to livestock farmers. The truth is that a farmer farms soil. In order to cultivate grass for livestock, the soil must be conserved. However, soil erosion poses a major threat to soil conservation, and it is the first thing that the farmer needs to combat to preserve the veld.

Discuss soil conservation and erosion and its impact on farming productivity.

Your discussions should have sub-headings as follows:

- Definition of soil erosion.
- Causes of soil erosion.
- Impact or effects of soil erosion on farming.
- Ways to promote soil conservation.

20 marks

Total: 300 marks