



NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2019

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. It is in your own interest to write legibly and to present your work neatly.
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SECTION A**QUESTION 1**

- 1.1 Various options are provided as possible answers to the following questions. Choose the answer and make a cross (X) in the block (A to D) next to the question number (1.1.1 to 1.1.10) on the attached ANSWER SHEET. NO marks will be awarded if more than one cross (X) appears for the answer.

EXAMPLE

1.1.11	<input checked="" type="checkbox"/> A	B	C	D
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- 1.1.1 In the South African binomial soil classification system, soils are grouped according to two main categories which are ...
- A genus and species.
 B forms and series.
 C class and series.
 D horizons and depth.
- 1.1.2 Which ONE of the following acts deals with issues that promote conservation practices and alien plant control?
- A Agricultural Products Standards Act, No. 119 of 1990
 B Fencing Act of 1993
 C Conservation of Agricultural Resources Act, No. 43 of 1983
 D Subdivision of Agricultural Land Act, No. 70 of 1970
- 1.1.3 Soil and water can be conserved by ...
- A building dams and walls in dongas.
 B removing all vegetation from soil.
 C building contour walls.
 D A and C
- 1.1.4 Zoonotic diseases are diseases that ...
- A if they occur, it is required by law to notify the government authorities.
 B can be transmitted from animals to humans and from humans to animals.
 C are non-infectious.
 D are caused by nutritional deficiencies.
- 1.1.5 The longest phase in the oestrus cycle where the corpus luteum reaches its maximum size and produces large amounts of progesterone.
- A Anoestrus
 B Oestrus
 C Di-oestrus
 D Met-oestrus

1.1.6 Some of the following are visible signs of sodic soil.

- (i) Aggregates of clay and other soil particles break up and disperse.
- (ii) Organic matter dissolves in soil solution and precipitates in the upper soil horizon to form black crust.
- (iii) Strong development of a prismatic structure.
- (iv) Soil surface tends to be powdery white.

Choose the correct combination.

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

1.1.7 The nucleus which controls the growth direction of the developing pollen tube is the ...

- A vegetative nucleus.
- B male gamete.
- C generative nucleus.
- D female gamete.

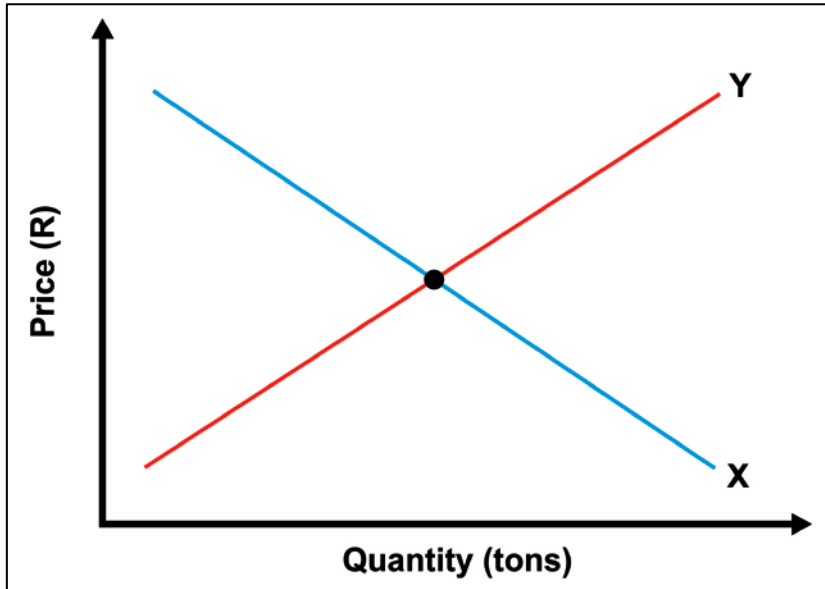
1.1.8 A heterozygous Brahman bull (Bb) was mated with a heterozygous cow (Bb). The expected genotype ratio in their F1 generation will be ...

- A 1:3:1
- B 3:1
- C 1:2:1
- D 2:2

1.1.9 ... is the use of technology such as computers, global satellites and remote sensing devices to monitor if crops are growing at maximum efficiency.

- A Greenhouse farming
- B Precision farming
- C Organic farming
- D Aerial farming

1.1.10 Which of the following straight-line graphs show(s) the various quantities of a product that are offered by sellers at different prices?



- A Both X and Y
- B Y
- C X
- D None

(20)

1.2 Determine whether the statements below are TRUE or FALSE. On the ANSWER SHEET provided, mark T for TRUE or F for FALSE.

- 1.2.1 Ecolabelling is a market-based tool to promote sustainable use of natural resources.
- 1.2.2 During the dry period the cow produces the highest amounts of milk.
- 1.2.3 Multiple alleles refer to two or more genes that have an influence on the phenotype of an organism.
- 1.2.4 The red-legged tick is an example of a two-host tick.
- 1.2.5 Controlled marketing is a system of marketing where two or more farmers work together to reach a common goal.
- 1.2.6 The stamen of the flower consists of the stigma, style and ovary.

(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	A tick-borne disease transmitted by a blue tick.
	B	Red water	

	A only	B only	A and B	None
1.3.7	A	B	C	D

	COLUMN A		COLUMN B
1.3.1	A B	Atavism Epistasis	Random change in the structure of DNA, resulting in a variant form, which may be transmitted to subsequent generations.
1.3.2	A B	Nuclear transfer Embryo transfer	A process where one organism with superior heritable traits is cloned to produce offspring that are genetically identical to the original organism.
1.3.3	A B	Risk-taking Innovation	Entrepreneurial success factors.
1.3.4	A B	Viral Bacterial	Examples of diseases caused by the micro-organisms are Anthrax and Mastitis.
1.3.5	A B	Genomes Alleles	Two genes that occupy the same position on homologous chromosomes and that cover the same trait.
1.3.6	A B	Dihybrid Monohybrid	Type of inheritance representing the Mendelian law of independent assortment.

(12)

- 1.4 Give the correct term for each of the following descriptions. Write only the term next to the question number (1.4.1–1.4.6) on the attached ANSWER SHEET.
- 1.4.1 The prediction of expected income and expenditure for a particular year.
- 1.4.2 Keeping animals in isolation for a fixed period of time to enable officials from the Department of Veterinary Services to test for and detect diseases.
- 1.4.3 The modification of the DNA resulting in a change in the sequence of the gene.
- 1.4.4 A single, narrow, coiled tube that transports sperm from testes to the vas deferens.
- 1.4.5 The labour legislation that regulates health and safety of all employees in the workplace.
- 1.4.6 An advanced technology that allows breeders to manipulate and make precise genetic changes to impart beneficial traits to the organism. (12)
- 1.5 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 (1.5.1–1.5.6) on the attached ANSWER SHEET.
- 1.5.1 Shortage indicates the condition when the quantity supplied is more than the quantity demanded.
- 1.5.2 Liabilities are physical items of economic value which could be converted to cash if sold by the farmer.
- 1.5.3 The falling of flowers and fruitlets within the first ten days of formation is known as parthenocarpy.
- 1.5.4 Germination is the transfer of pollen from a male part of a plant to a female part of a plant, enabling later fertilisation and the production of seeds.
- 1.5.5 Movable capital is the type of capital represented by a feed shed on a farm.
- 1.5.6 The breeding method where purebred males of a specific breed are mated generation after generation with inferior females is inbreeding. (12)

1.6 Choose a term/phrase from COLUMN B that matches a description in COLUMN A. Write only the letter (A–L) next to the question number (1.6.1–1.6.6) on the attached ANSWER SHEET. Example: 1.6.7 T.

1.6.1	Crossing of plants with different characteristics to get a combination of desirable traits in the offspring.	A	Drenching gun
		B	Allantois
1.6.2	A type of soil degradation that involves over-utilisation of commercial fertilisers in the soil.	C	Asexual
		D	Physical
1.6.3	The membrane that grows out of the urinary system of an embryo and helps to collect urine from an unborn calf.	E	Internet marketing
		F	Chorion
1.6.4	Products and services are marketed via e-mails and online media.	G	Mutation
		H	Direct marketing
1.6.5	An instrument used by farmers to place a pill or bolus in the throat of a sick animal.	I	Balling gun
		J	Sexual
1.6.6	Reproduction that involves fusion of a male pollen grain and the female ovum to produce a seed.	K	Chemical
		L	Hybridisation

(12)

80 marks

SECTION B

Answer Questions 2–6 in your Answer Book.

QUESTION 2

2.1 Read the following extract on soil surveying and planning.

Soil erosion and land degradation: the global risks

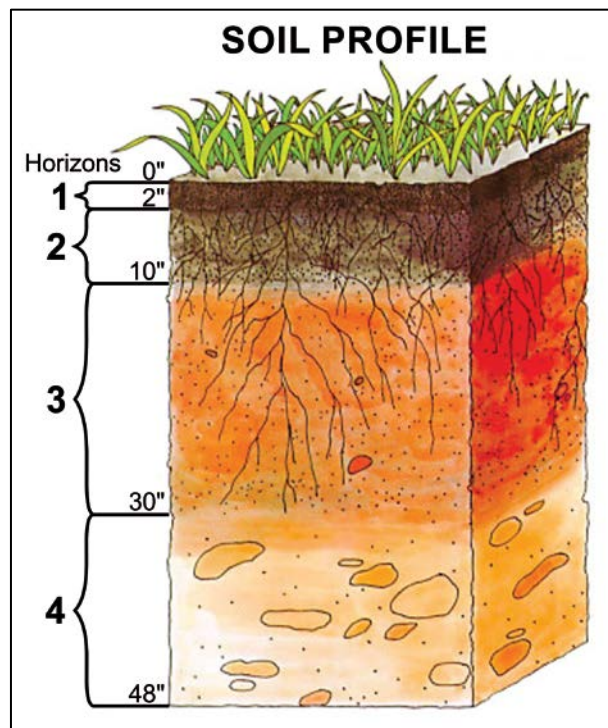
The total land area of the world exceeds 13 billion hectares, but less than half of it can be used for agriculture, including grazing. The world's potential arable land is estimated at 3 031 million hectares or 22% of the total land area. Soil is one of the main resources which the farmer can utilise for production and it needs special care. Soil surveys and the resultant soil mapping is aimed at utilising soil for the production purpose for which it is most suited.

[Extracted from By Rattan Lal, Advances in soil science, 129–172, 1990]

2.1.1 Indicate TWO aims of soil surveys in agriculture. (2)

2.1.2 Briefly explain the soil survey process. (6)

2.2 Soil scientists visited a farm to do soil classification to ensure optimal use of the soil and came up with the results displayed below.

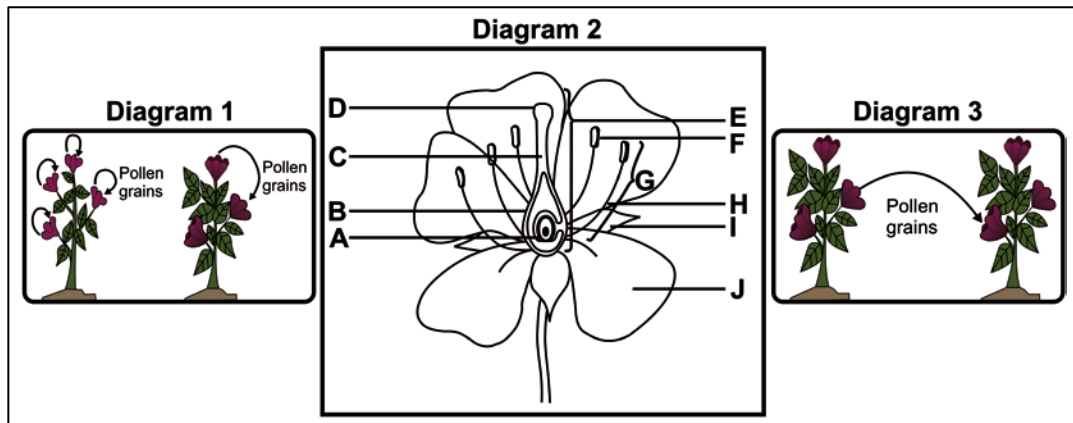


[<<https://upload.wikimedia/soil profile.png>>]

2.2.1 Identify soil horizons labelled **1**, **2**, **3** and **4** in the soil profile above. (4)

2.2.2 Give the characteristics of each soil horizon identified in Question 2.2.1. (8)

2.3 Diagrams 1 and 3 illustrate the transfer of pollen from a male part of a plant to a female part of a plant, enabling fertilisation and the production of seeds.



[Adapted from <<https://qforquestions.com/describe>>]

- 2.3.1 Identify the process illustrated in Diagrams 1 and 3 above. (2)
- 2.3.2 The process identified in Question 2.3.1 can be divided into different types, as illustrated by Diagrams 1 and 3 above. Name the type represented by:
- (a) Diagram 1 (2)
 - (b) Diagram 3 (2)
- 2.3.3 State the **letter** and **name** of the part of the flower in Diagram 2 responsible for the following:
- (a) Acts as a female reproductive organ of a flower
 - (b) It develops into a fruit
 - (c) Sticky tip that serves to trap pollen grains
 - (d) Serves the purpose of a male reproductive organ
 - (e) Slender tube that transports pollen to the ovary (10)
- 2.3.4 Name THREE agents of the process identified in Question 2.3.1. (3)

2.4 Production factors are the resources required for the generation of products, goods or services. The table below shows characteristics, examples and rewards for each production factor:

PRODUCTION FACTORS	CHARACTERISTICS	EXAMPLES	REWARDS
A	Physical and mental input	Workforce	D
B	Soil and extracted resources	Farm and crops	Rent
C	Fixed and working	Machinery	Interest
Entrepreneurship	Organisational factors	Manager	E

- 2.4.1 Identify the production factors **A**, **B** and **C** in the table above. (3)
- 2.4.2 Name the production factor rewards labelled **D** and **E** in the table above. (2)
- 2.4.3 Indicate ONE function of land in economic terms. (2)
- 2.4.4 Differentiate between an enterprise budget and a whole-farm budget. (4)

[50]

QUESTION 3

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

Top Sussex breeder's extreme measures to beat stock theft

By Mike Burgess

October 8, 2018 11:05 am

Linden Hewson owns the 2017 Farmer's Weekly/ARC National Best Elite Sussex cow. The achievement is significant, as the Grey Maclean Stud near East London has been kraaled every night since 2002 to keep the animals safe. Sussex stud breeder and qualified chartered accountant, Linden Hewson, admits that when 10 pregnant stud cows were slaughtered by stock thieves in the space of three months in 2002, he considered emigrating. He was deterred, however, by his long-held love of farming beef cattle and his determination to continue improving his stud on his 130 ha family farm. Linden's beef initiative has its roots in a few crossbred heifers he received from his father, Mellie, while still in pre-primary school. It triggered a lifelong passion that is today illustrated by a stud which produced one of the country's finest Sussex cows (LJ 06 0209), with an intercalving period (ICP) of 359 days over 10 calves.

This achievement is all the more remarkable considering that Linden has to spend great effort and cost to protect his stud animals, including 80 breeding females, from stock thieves. Kraaling under the supervision of a guard has been the norm on Grey Maclean for the past 16 years. Currently a guard from Daymax Security – in cellphone contact with a dispatch vehicle – stays on the farm from 6 p.m. to 6 a.m., seven days a week, at a cost of R8 300 a month, excluding VAT.

Grey Maclean farm is defined by heartwater, redwater and gall sickness veld. All cattle introduced to the farm therefore undergo a strict summer and winter 'blocking' regime. Linden does not use blood vaccines as he has lost faith in the efficacy of the live vaccine. Dipping takes place every 10 days in summer and every 14 to 18 days in winter.

Artificial Insemination (AI) has always been an important tool to ensure genetic progression in the Grey Maclean stud. Linden uses semen from bulls across the country, as well as from self-bred bulls and he believes in storing semen from proven sires for future use.

[Farmer's Weekly October 2018]

3.1.1 A SWOT analysis is a simple but useful framework to analyse and understand the business.

- (a) Identify the FOUR components of the SWOT analysis. (4)
- (b) Do a SWOT analysis for the business above by providing TWO examples for each component mentioned in Question 3.1.1 (a). (8)

3.1.2 Farmers are required by law to mark their animals for identification purposes. Name THREE identification methods that can be used in beef breeds. (3)

3.1.3 Grey Maclean farm is defined by heartwater, redwater and gall sickness veld.

(a) Indicate the main micro-organism causing heartwater, redwater and gall sickness. (1)

(b) Provide the other name for gall sickness. (1)

3.1.4 Complete the following table:

Disease	Mode of transmission	Symptoms
Gall sickness		
Redwater		
Heartwater		

(6)

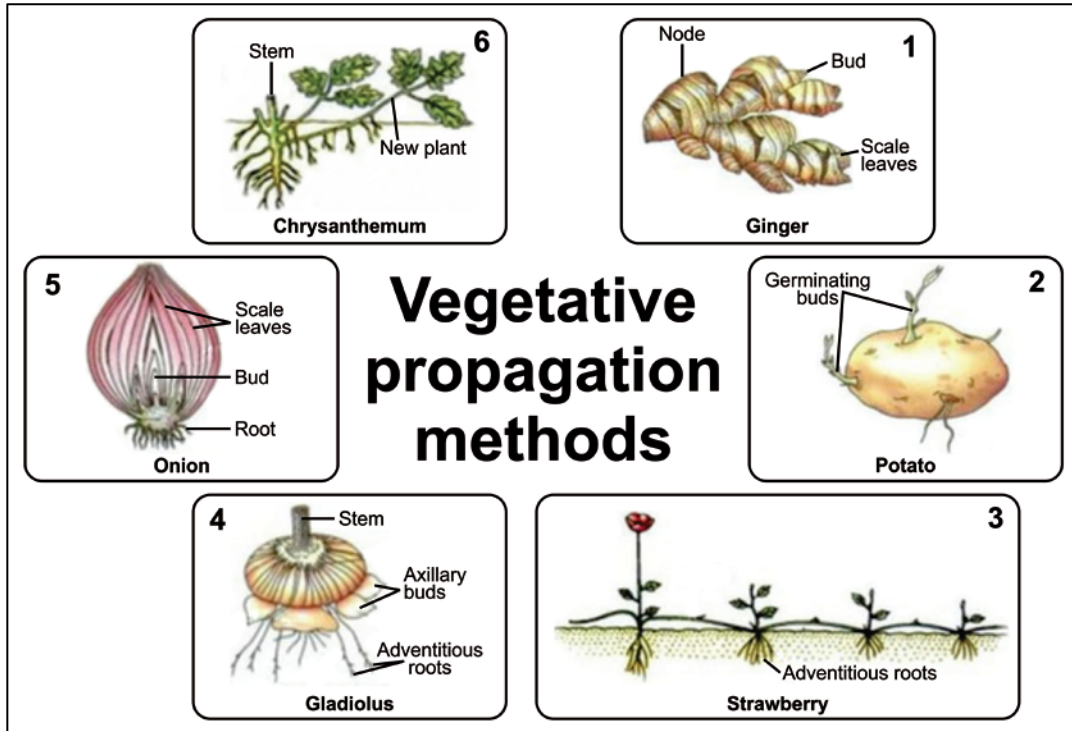
3.1.5 Artificial Insemination (AI) has always been an important tool to ensure genetic progression in the Grey Maclean stud. Linden uses semen from bulls across the country, as well as from self-bred bulls and he believes in storing semen from proven sires for future use.

(a) Tabulate TWO advantages and disadvantages of AI. (4)

(b) Name TWO basic storage requirements of collected semen. (2)

(c) List TWO characteristics of good-quality semen. (2)

3.2 Vegetative reproduction is a form of asexual reproduction where a new plant grows from a vegetative part of the parent plant.

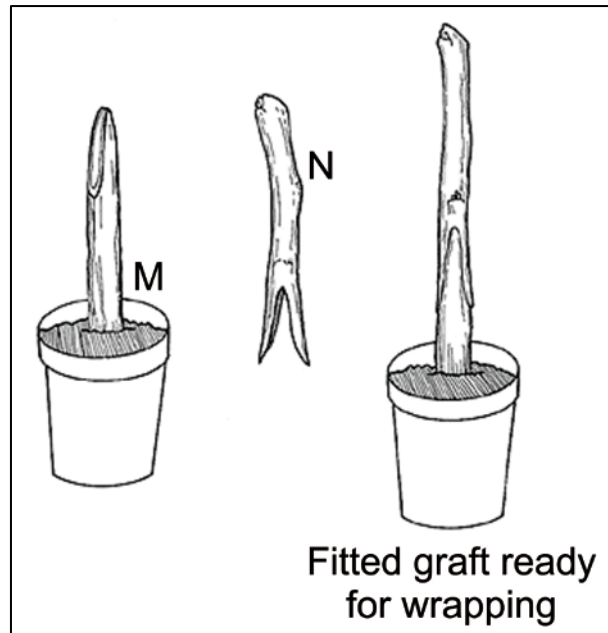


[Extracted from "An Introduction to Vegetative Reproduction" by D. G. Mackean & Ian Mackean, 2004]

Indicate the number of the asexual method of reproduction in the diagram above that represents the following:

- 3.2.1 Bulbs (1)
- 3.2.2 Runners (1)
- 3.2.3 Rhizomes (1)
- 3.2.4 Sucker (1)

3.3 Grafting and budding are techniques used to join parts from two or more plants so that they appear to grow as a single plant. Although budding is considered a modern art and science, grafting is not new.



- 3.3.1 Identify the parts labelled **M** and **N** in the diagram above. (2)
- 3.3.2 Define:
- (a) Grafting (2)
 - (b) Budding (1)
- 3.3.3 (a) Grafting can be done using three different techniques. Name ONE. (2)
- (b) Describe the technique mentioned in Question 3.3.3 (a). (2)
- 3.3.4 What do we call a person who is highly trained to use the techniques mentioned above? (2)
- 3.3.5 Tabulate TWO advantages and disadvantages of using asexual reproduction methods to propagate plants. (4)

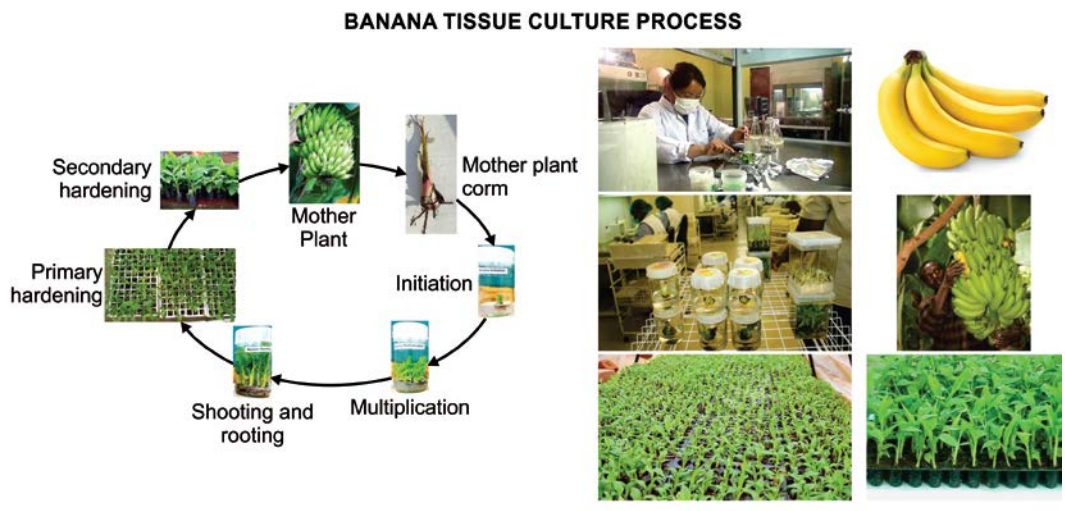
[50]

QUESTION 4

4.1 Read the following case study and then answer the questions that follow.

The role of community engagement in the adoption of new agricultural biotechnologies: the case of the Africa harvest tissue-culture banana in Kenya

Agricultural biotechnology is an advanced technology that allows plant and animal breeders to make precise genetic changes to impart beneficial traits to the crop plants and animals we rely on for food and fibre. The tissue culture banana (TCB) is a biotechnological agricultural innovation that has been adopted widely in commercial banana production. In 2003, Africa Harvest Biotech Foundation International (AH) initiated a TCB program that was explicitly developed for smallholder farmers in Kenya to help them adopt the TCB as a scalable agricultural business opportunity.



Production of bananas using tissue culture banana against natural production:

YEAR	TISSUE CULTURE BANANA PRODUCTION (kg)	NATURAL PRODUCTION OF BANANAS (kg)
2003	500	200
2004	800	450
2005	1 000	650
2006	1 500	800
2007	2 200	1 200

[Extracted from the case study by: Bandewar, Sunita V S; Wambugu, Florence; Richardson, Emma; Lavery, James V; 2017-03-13. Clinical Epidemiology & Biostatistics Department, Faculty of Health Sciences, McMaster University, Hamilton, Canada]

4.1.1 Explain the process of plant tissue culture. (3)

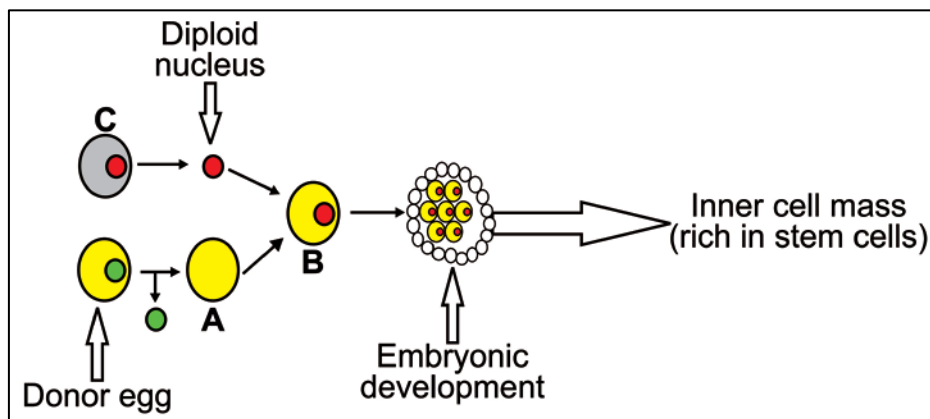
4.1.2 Briefly describe the importance of plant tissue culture applications for genetic engineering in crop production. (4)

- 4.1.3 Draw a fully labelled bar graph that shows the difference in production of bananas between tissue culture and the natural method from 2003 to 2007. (8)
- 4.1.4 Deduce the trend in terms of production between the two methods. (3)
- 4.1.5 Calculate the total banana production in tons over the five years for:
 - (a) Tissue culture (4)
 - (b) Natural (4)

4.2 In summer, the white fruit colour (W) of squash is dominant over the yellow fruit colour (w) and disc-shaped fruit (D) is dominant over sphere-shaped fruit (d). If a squash plant true-breeding for white, disk-shaped fruit is crossed with a plant true-breeding for yellow, sphere-shaped fruit:

- 4.2.1 Determine the genotype of the F₁ generation. (2)
- 4.2.2 Use a Punnet square to illustrate the results of a cross between two of the F₁ generation offspring as parents. (7)
- 4.2.3 Determine the phenotypic ratio for the F₂ generation with a clear indication of colour and shape for each component of the ratio. (5)

4.3 The diagram below represents a reproductive process:



- 4.3.1 Identify the reproductive process indicated in the diagram above. (1)
- 4.3.2 Provide labels for the parts indicated as A, B and C. (3)
- 4.3.3 Indicate TWO types of the reproductive process indicated in Question 4.3.1. (2)
- 4.3.4 Differentiate between the TWO types of the reproductive process indicated in Question 4.3.3. (4)

[50]

QUESTION 5

5.1 Meat marketing planner: strategic marketing for farm-to-table meat enterprises

A marketing plan is a major component of a larger business tool, the business plan. Other business plan sections include finances, production, and human resources. Marketing should serve as the keystone in your business plan for designing a sustainable business. Your marketing decisions will impact a wide variety of production decisions – which breed(s) to raise, pasture establishment and maintenance, grazing rotations, breeding and meat harvesting schedules, and the labour needed for both production and marketing tasks. The most successful producers consider their marketing strategies long before they sell either live animals or processed products.

The marketing channel drives all the other marketing plan components. It determines where and how the meat must be processed, the logistics involved in sales and delivery, the use of technology, which marketing tools are most effective and the degree of customer service required to grow the business. Regulations for livestock slaughter and meat processing vary depending on which channel the farmer uses to market his or her product. Consider that you need to sell the whole carcass to be profitable. It is easy to sell high-end cuts such as steaks, but much harder to sell low-end cuts. When selecting your market outlet, also consider seasonality. The following table gives examples of how many kilograms of each cut you can expect from a side of beef of about 300 kg of saleable product.

Summary of cuts	Kilograms
Roasts	81,5
Steaks	41,8
Ground beef	133,7
Stew	20,0
Miscellaneous	23,0

[Source: American Meat Institute and USDA]



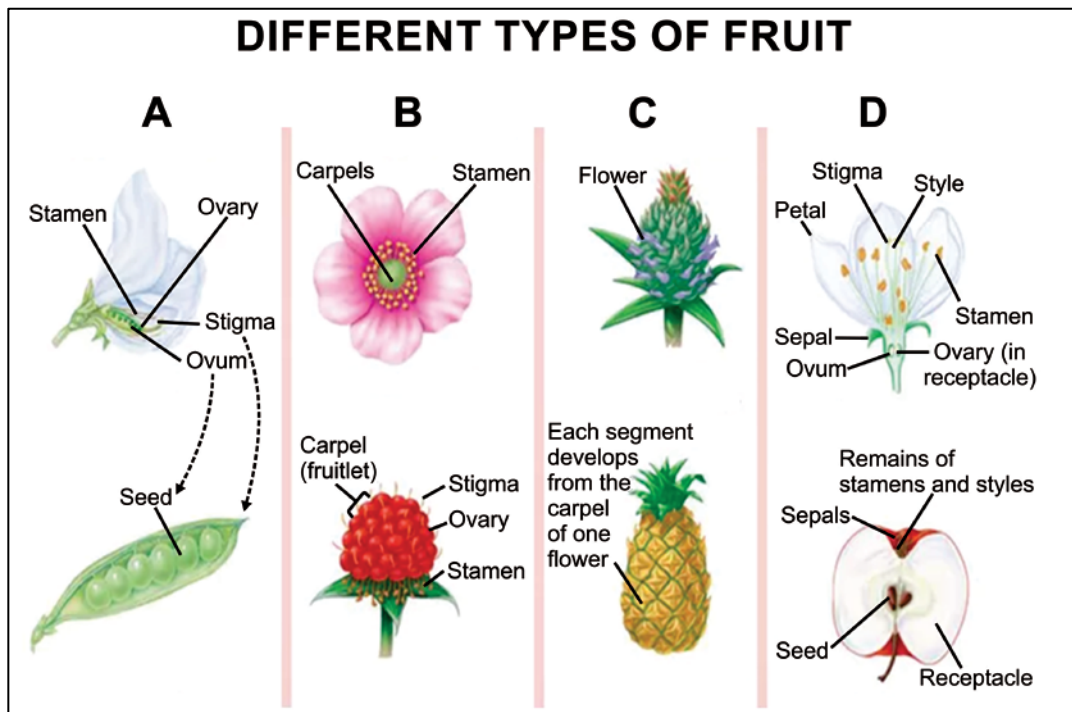
Individual producers often experience difficulties in profitably, achieving neither the level of marketing services nor the volume necessary to service large retail outlets like grocery stores or institutional markets such as schools and hospitals. To meet this larger volume market, several producers can pool their animals and share the fixed costs. Marketing decisions generally fall into the four controllable categories of "marketing mix" which became popularised after Neil H. Borden published his 1964 article, "The Concept of the Marketing Mix".

[University of Maryland Extension website at <www.extension.umd.edu>]

- 5.1.1 Indicate the marketing system represented by the farmers who come together and pool their animals and share the fixed costs. (2)
- 5.1.2 Name the TWO types of the marketing system indicated in Question 5.1.1. (2)

- 5.1.3 Briefly explain TWO benefits of the marketing system indicated in Question 5.1.1. (4)
- 5.1.4 List FOUR components of the Marketing Mix. (4)
- 5.1.5 Calculate the percentage of the ground beef cut from a side of beef of about 300 kg of saleable product. (3)
- 5.1.6 Describe TWO factors that can have a negative influence on the marketing chain for the above case. (4)
- 5.1.7 Provide the remedial action related to the challenges in Question 5.1.6. (4)

5.2 The diagram below shows different types of fruit.



[<<https://www.google.com/search?q=fruit+classification>>]

- 5.2.1 Identify the types of fruit labelled **A**, **B**, **C** and **D** in the diagram above. (4)
- 5.2.2 Classify the examples of fruit listed in the box below into the categories identified in Question 5.2.1 above. (4)

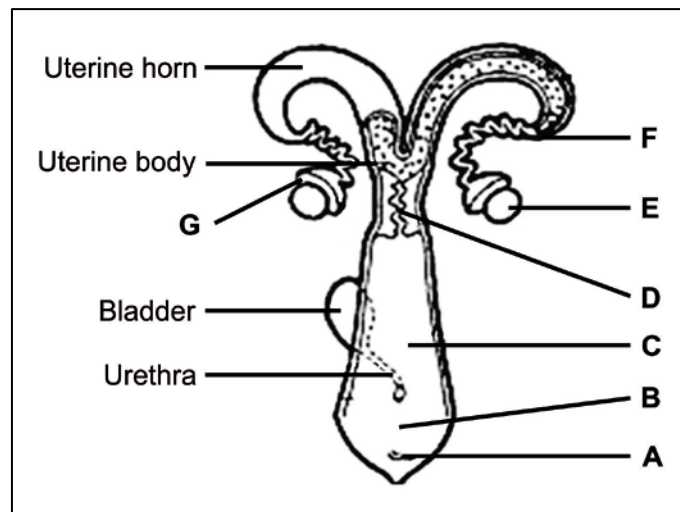
strawberries, figs, pears, grapes

5.3 The following data was gathered about the financial operations of two poultry farmers. Analyse the data and answer the questions that follow.

Description of item	Amount (R)	
	Farmer A	Farmer B
Bought 2 000 chickens	2,50 (each)	2,00 (each)
Paid for labour	58 000	28 000
Sold chicken manure	19 000	29 000
Bought chicken feeders	10 000	20 000
Paid for water	4 000	2 000
Sales of meat products	39 000	122 000
Bought vaccines	500	15 000

- 5.3.1 Use the data to design a cashflow budget for farmer **A** and farmer **B**. (8)
- 5.3.2 Determine whether these two farmers' businesses are viable and healthy. Give a reason for your answer. (4)
- 5.3.3 Which poultry product can the two farmers include in their budget to increase earnings? (1)

5.4 The diagram below illustrates the reproductive system of a cow.



[<<https://google/female animal reproductive system images>>]

- 5.4.1 Identify the parts labelled **G**, **F** and **B** in the diagram above. (3)
- 5.4.2 Match the functions listed below with a letter in the diagram above:
 - (a) Produce female gametes and hormones (1)
 - (b) Organ of copulation (1)
 - (c) Physical barrier to the uterus; secretes mucous that forms a cervical plug during pregnancy (1)

[50]

200 marks

SECTION C**QUESTION 6**

Read the following scenario and then answer the question that follows.

The need to control internal parasites will exist in agriculture as long as cattle are grazing pastures. However, parasite levels are not the same on all pastures or in all cattle. Pastures that are heavily stocked generally have a higher parasite burden than lightly stocked ones. Cattle on high-rainfall pastures are more likely to have heavy worm infections than those in dry hot areas. Young cattle will typically have more internal parasites than older cattle.

Food security is affected by the effects of diseases on animal products. Discuss the detrimental effects of internal parasites on the livestock industry and its impact on food security.

Your discussion should include:

- Definition of parasites and differentiation between ectoparasites and endoparasites.
- Different types of the most important internal parasites.
- Financial and detrimental effects of internal parasites and its impact on food security.
- The preventative/control measures of internal parasites.

20 marks**Total: 300 marks**