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TOTAL MARKS

NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2021

AGRICULTURAL SCIENCES

EXAMINATION NUMBER

Time: 3 hours 300 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. Write your examination number in the blocks provided above.
2. This question paper consists of 40 pages. Please check that your question paper is complete.
3. This question paper consists of **THREE** sections, namely **SECTION A**, **B** and **C**.
4. ALL SIX questions must be answered in the spaces provided on the question paper.
5. Read the questions carefully.
6. Use the marks awarded for each question as an indication of the detail required.
7. Non-programmable calculators may be used.
8. Show all your calculations, including formulae and units, where applicable.
9. It is in your own interest to write legibly and to present your work neatly.
10. Two blank pages (pages 39 and 40) are included at the end of the paper. If you run out of space for a question, use these pages. Clearly indicate the number of your answer should you use this extra space.

SECTION A

QUESTION 1

1.1 The table below shows different types of fruit. Match the type of the fruit in Column B to the description and examples of the fruit in Column A. Write the type of fruit down next to the question number.

	COLUMN A	**COLUMN B**
1.1.1	Has a hard, wood-like texture, opens when ripe to set seeds free, such as sweet pea.	Accessory fruit
1.1.2	Fruit that develops from a ripened ovary and has tissue that comes from parts of the plant outside the ovary, such as apples and pears.	Multiple fruit
1.1.3	Fleshy fruit developing from a group of independent flowers, such as figs and pineapples.	Compound fruit
1.1.4	Has a hard, wood-like texture, does not open when ripe to set seeds free and an example is blossom and fruit of almond.	Fleshy simple fruit
1.1.5	Develops from flowers with many ovaries, such as blackberries and strawberries.	Dehiscent dry simple fruit
1.1.6	Has a soft, fleshy pericarp, such as tomatoes and grapes.	Indehiscent dry simple fruit

1.1.1 _____

1.1.2 _____

1.1.3 _____

1.1.4 _____

1.1.5 _____

1.1.6 _____

(12)

1.2 Four options (A to D) are provided as possible answers to the following questions. Make a cross (X) in the block next to the correct answer. NO marks will be awarded if more than one option is marked.

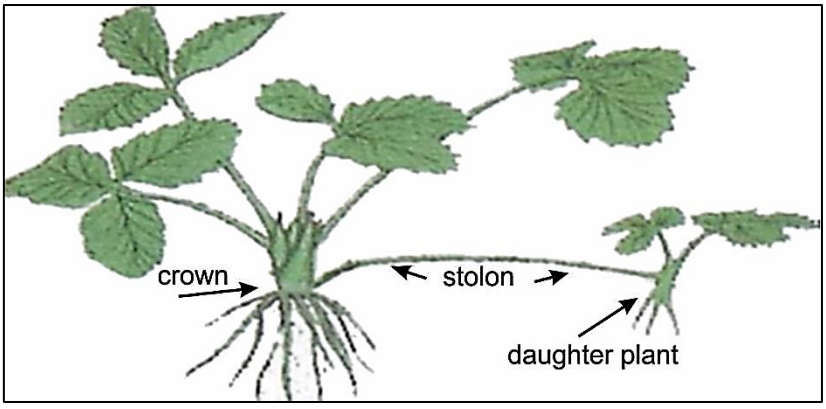
1.2.1 Planting of more than one crop on a single piece of land with the aim of increasing plant density is known as …

A	crop rotation.	☐
B	monoculture.	☐
C	intercropping.	☐
D	green manuring.	☐

1.2.2 The nucleus that controls the growth direction of the developing pollen tube is the ...

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

1.2.3 The diagram of the plant below is an example of the propagation method through ...



A	a bulb.	☐
B	a rhizome.	☐
C	a corm.	☐
D	runners.	☐

1.2.4 Which one of the following acts deals with issues that promote conservation practices and alien plant control?

A	Subdivision of Agricultural Land Act, No. 70 of 1970.	
B	Fencing Act, No. 31 of 1963.	
C	Conservation of Agricultural Resources Act, No. 43 of 1983.	
D	Agricultural Products Standards Act, No. 119 of 1990.	

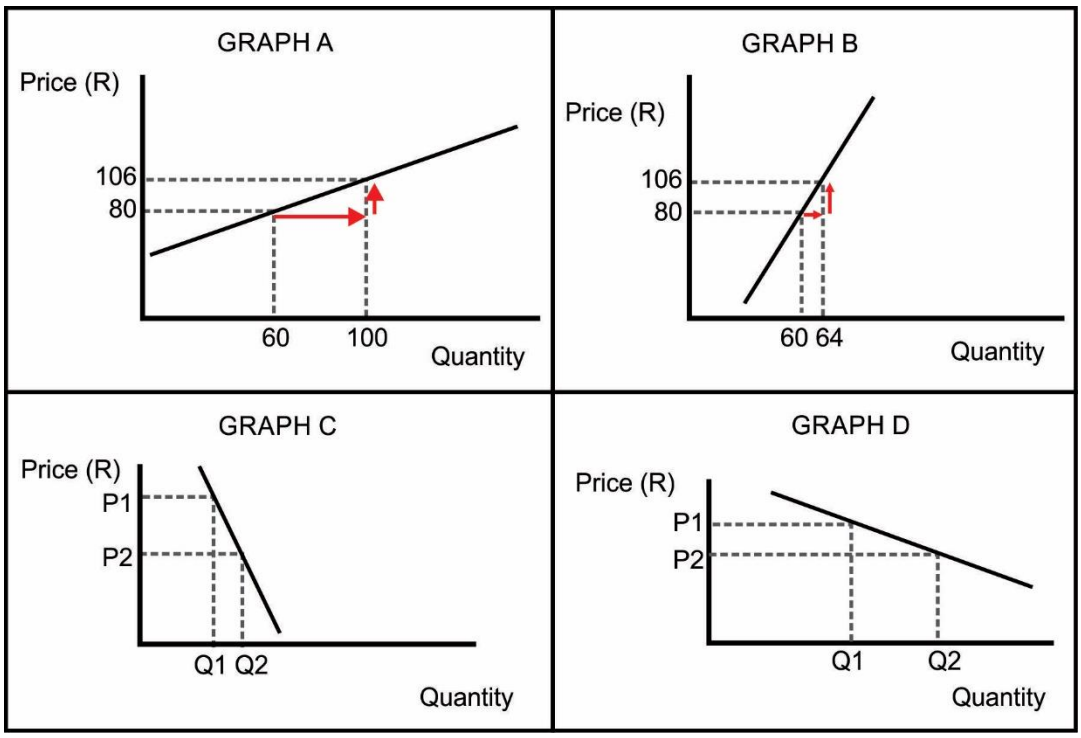
1.2.5 Some of the following statements apply to mastitis:

(i) Symptoms include a quarter udder that is hot, swollen and painful.
(ii) Can be categorised as a viral disease.
(iii) Affects dairy cows.
(iv) Antibiotics, such as penicillin and streptomycin, can be used to treat it.

Choose the CORRECT combination:

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

1.2.6 Price elasticity of demand is a measure used in economics to show the responsiveness of the quantity demanded of a good or service to a change in its price when nothing but the price changes. The graph that illustrates an inelastic demand well is ...



A Graph A ☐

B Graph B ☐

C Graph C ☐

D Graph D ☐

1.2.7 A form of agriculture that relies on organic sources of input to create a naturally balanced ecosystem is known as ...

A permaculture. ☐

B horticulture. ☐

C viticulture. ☐

D precision farming. ☐

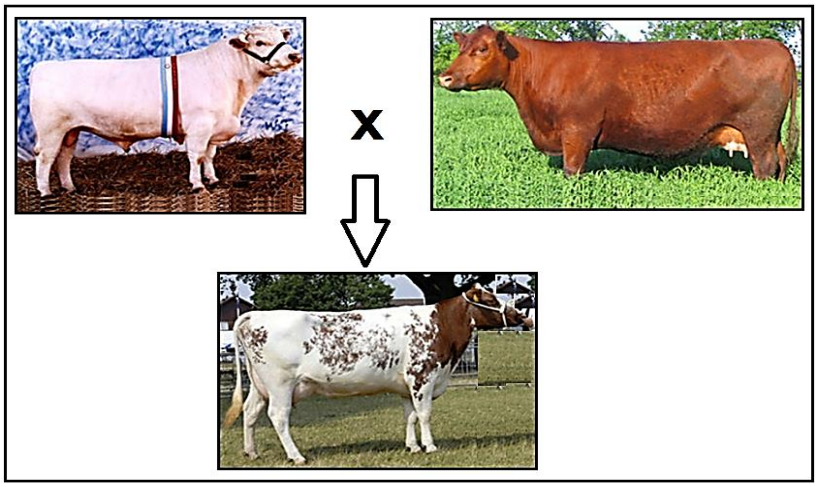
1.2.8 The following are some of the characteristics of internal parasites:

(i) Also known as endoparasites.
(ii) Lower the production of the host animal.
(iii) Roundworms and tape worms are good examples.
(iv) Parasites that feed on blood through the skin of animals.

Choose the CORRECT combination:

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

1.2.9 The pattern of inheritance represented by the diagram below is …



A incomplete dominance ☐
B epistasis ☐
C atavism ☐
D co-dominance ☐

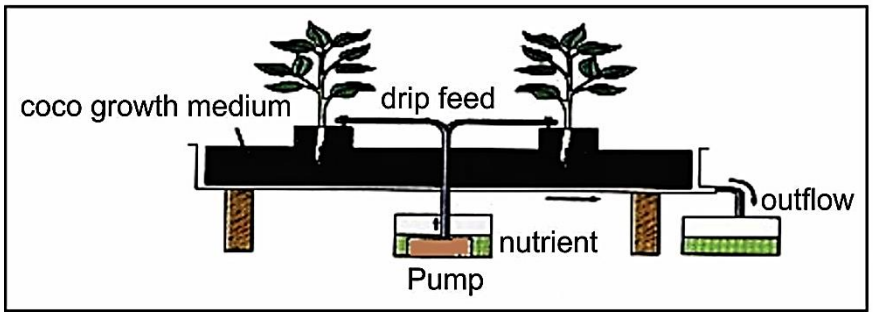
1.2.10 Colostrum is vital in the calving process. ONE of the following is NOT a reason for the importance of colostrum to young animals.

A It induces growth of the mammary glands. ☐
B It provides antibodies to protect new-born animals. ☐
C It supplies nutrition to the calf. ☐
D It contains factors for the growth, functioning and maturation of the alimentary canal. ☐

(20)

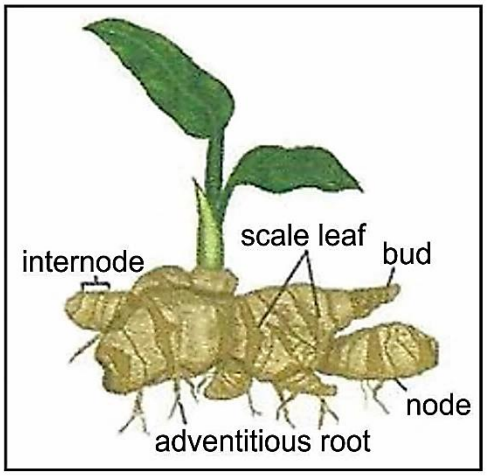
1.3 Each of the following questions has a sketch and two labels, A and B. Indicate in the table on page 9 whether only A, only B, A and B, or neither A nor B relates to the sketch.

1.3.1



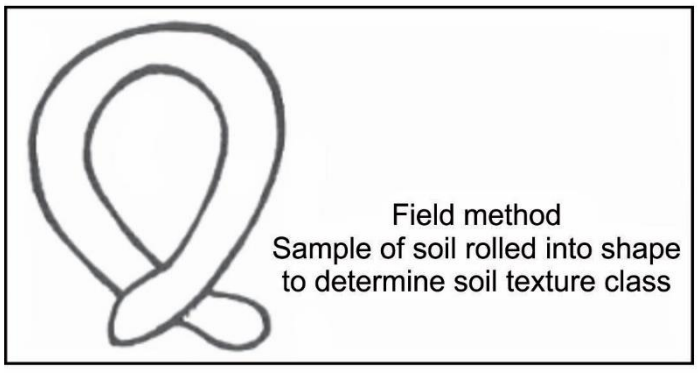
A Fermentation process
B Hydroponics

1.3.2



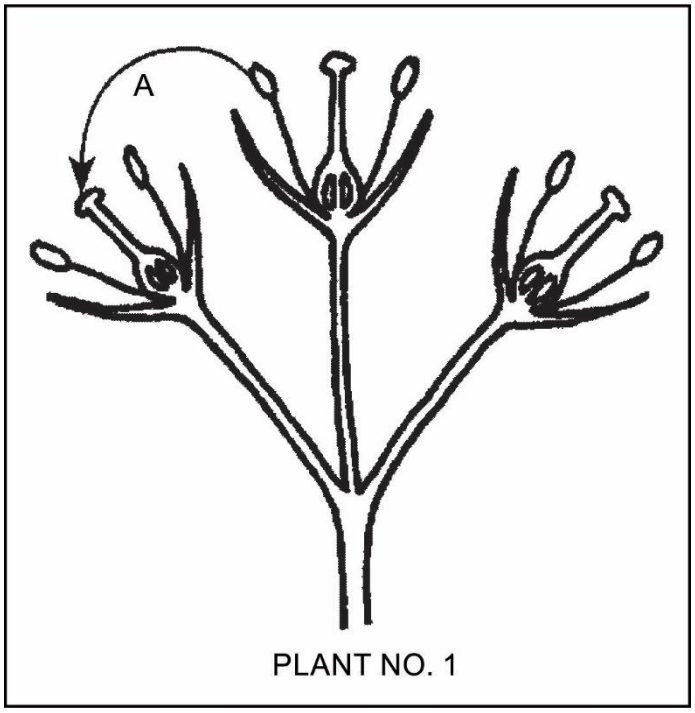
A Rhizome
B Tuber

1.3.3



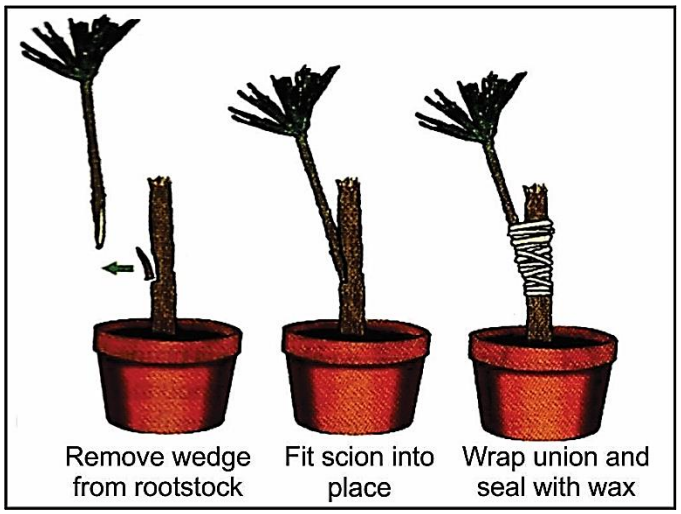
A Sandy loam
B Sand

1.3.4



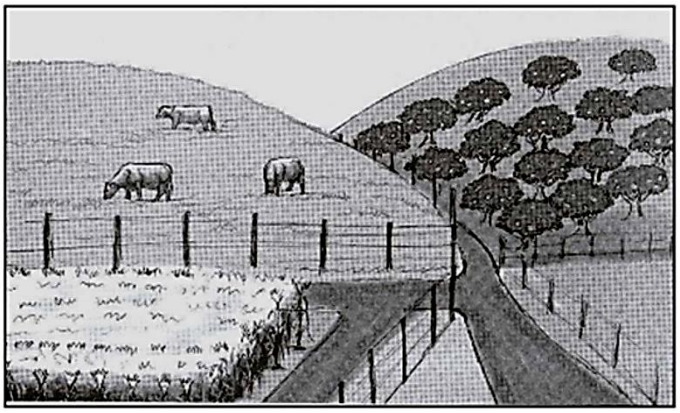
A Letter A shows self-pollination
B Letter A shows cross-pollination

1.3.5



A Budding
B Grafting

1.3.6



A Production factor visible in the picture is land
B Production factor visible in the picture is capital

	Only A	Only B	A and B	Neither A nor B
1.3.1				
1.3.2				
1.3.3				
1.3.4				
1.3.5				
1.3.6				

(12)

1.4 Give the correct term for each of the following descriptions.

1.4.1 The process of improving cultivars by choosing the best plants from which to collect seed.

_____

(2)

1.4.2 The point where the price of a product settles at and where demand is equal to supply.

_____

(2)

1.4.3 A single supplier controls the supply of goods/services without competition and may manipulate prices.

_____

(2)

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

_____

(2)

1.4.5 The mixture of sperm cells and the fluids from glands that are released during ejaculation.

_____

(2)

1.4.6 Differences in characteristics between individuals of the same species.

_____

(2)

1.5 Change the UNDERLINED WORD(S) in each of the following statements to make the statements TRUE. Write only the correct word(s).

1.5.1 Fertilisation is the process when the blastocyst attaches to the wall of the uterus.

_____ (2)

1.5.2 Sertoli cells are responsible for the production of testosterone in the male reproductive system.

_____ (2)

1.5.3 Selection refers to a situation where organisms are separated from others until it is known that there is no danger of spreading disease.

_____ (2)

1.5.4 Ammonification is the conversion of ammonia or another nitrogen compound into nitrites or nitrates.

_____ (2)

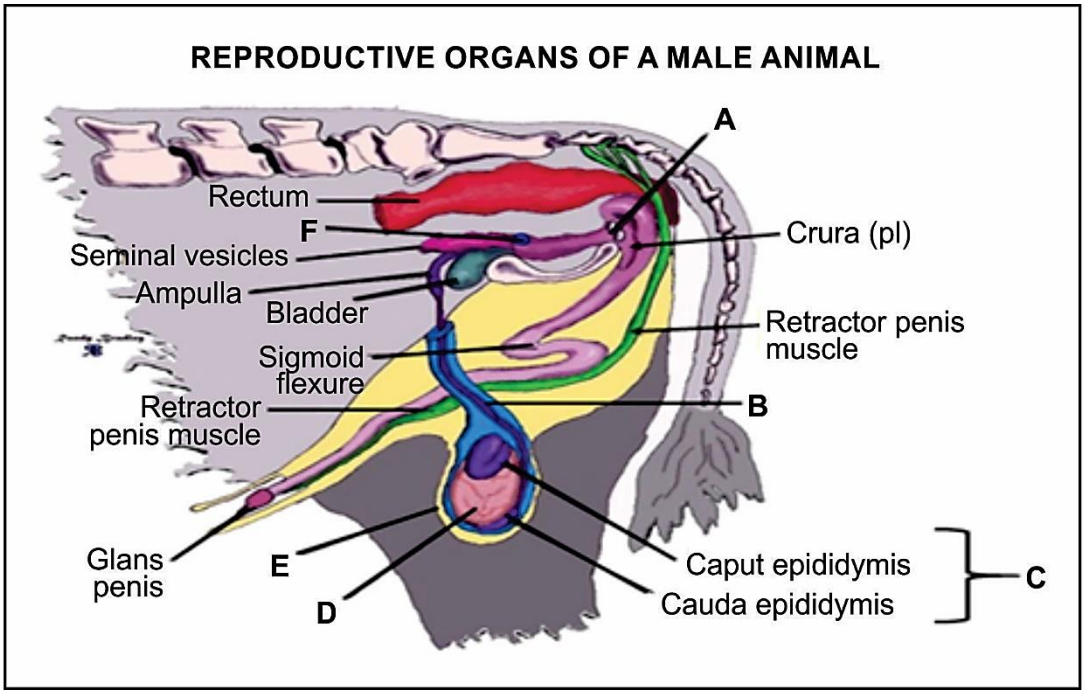
1.5.5 Xerophytes are plants that are unwanted in cultivated lands or grazing fields.

_____ (2)

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

_____ (2)

1.6 The diagram below represents the reproductive system of a bull. Study the functions of the reproductive organs listed below the diagram and match each with the correct organ (A–F) from the diagram.



1.6.1 Helps in the storage and maturation of spermatozoa.

_____ (2)

1.6.2 Serves as a protection, support system and control of temperature in the testis.

_____ (2)

1.6.3 Secretes a substance that lubricates, washes and flushes urine residue from the urethra.

_____ (2)

1.6.4 Primary reproductive organ for the production of sperm cells and the hormone testosterone.

_____ (2)

1.6.5 Secretes a milky, slightly alkaline mucus for semen smell and maintains correct pH.

_____ (2)

1.6.6 Transportation of spermatozoa from the epididymis to the urethra.

_____ (2)

80 marks

SECTION B

QUESTION 2

2.1 Various agricultural practices can lead to the pollution of the environment. Soil is the most important resource in agriculture that needs to be protected and cared for, and the only way to do that is to know more about the soil on the farm.

2.1.1 Define *agricultural pollution*.

(2)

2.1.2 Give FOUR examples of incorrect agricultural practices that pollute the environment.

(8)

2.1.3 Explain THREE main aims and principles of a soil survey.

(6)

2.2 The picture below is based on a technique that is used in the propagation of plants.

2.2.1 Identify the asexual reproduction technique that is illustrated above.

(1)

2.2.2 Indicate the most suitable structure or place (environment) where this technique can be practised on a large scale.

(1)

2.2.3 Name TWO essential factors visible from the picture on page 13 that will lead to the development of the plantlet.

_____

_____

(4)

2.2.4 Suggest TWO advantages of using this technique in agriculture.

_____

_____

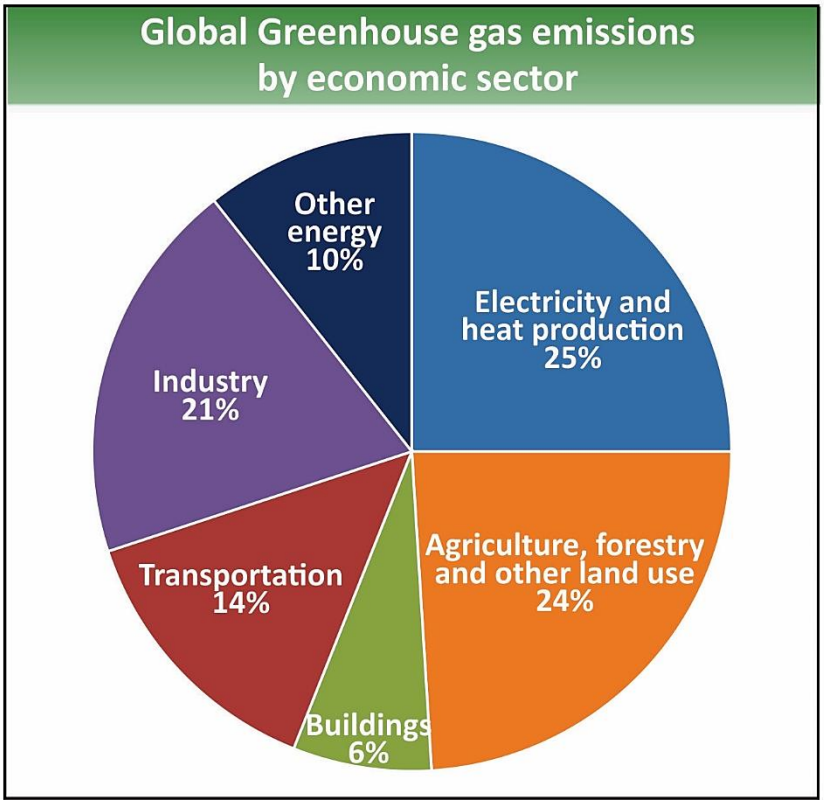
(4)

2.2.5 Name a type of chemical that could be added to the solution to promote root growth.

_____

(1)

2.3 Global carbon emissions from fossil fuels have increased since 1900. Since 1970, CO_2 emissions have increased by about 90%, with emissions from fossil fuel combustion and industrial processes contributing about 78% of total greenhouse gas emissions. Agriculture, deforestation and other land-use changes have been the second largest contributors.



[Source: Boden, T.A, Marland G. (2017). Global, regional and national fossil-fuel CO_2 emissions (IPCC: 2014)]

2.3.1 Convert the pie chart on global greenhouse gas emissions on the previous page into a bar graph with a heading.

(10)

2.3.2 Name FIVE major causes of the greenhouse effect.

(5)

2.3.3 Define the term *global warming*.

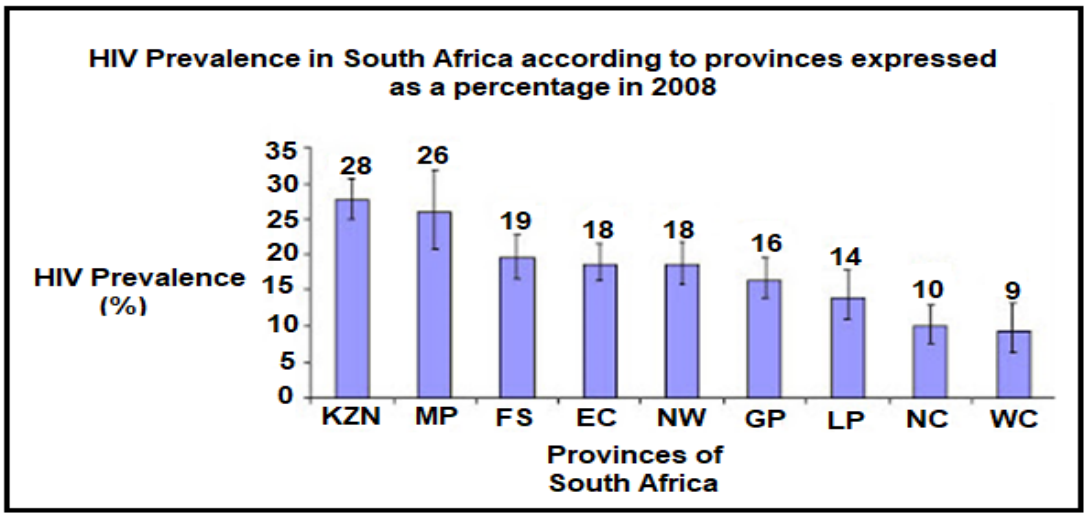
(2)

2.3.4 Global warming has far-ranging environmental and health effects. Describe any THREE of these effects.

(6)
[50]

QUESTION 3

3.1 The graph below shows HIV prevalence in South Africa in 2008:



3.1.1 Identify the South African province that had:

(a) The highest prevalence of HIV in 2008. Write down the name of the province and its percentage.

_____

_____

(2)

(b) The lowest HIV prevalence of HIV in 2008. Write down the name of the province and its percentage.

_____

_____

(2)

3.1.2 Farmers can encounter a range of problems with their labour force such as lack of skills and labour shortages due to different reasons.

Describe the possible impact of high HIV-AIDS infections on:

(a) Availability of labour on farms.

_____

_____

(2)

(b) Productivity of farm labour.

_____

_____

(2)

3.1.3 Suggest THREE measures that a farmer or farm manager can take to limit the impact of HIV-AIDS on the agricultural labour force.

(6)

3.2 The table below shows diseases, pathogens, symptoms and types of animal:

DISEASE	PATHOGEN	SYMPTOMS	TYPE OF ANIMAL
Mastitis	Bacteria	**A**	Farm animals
B	Virus	Rapid breathing, green diarrhoea, twisted neck	Poultry
Redwater	**C**	Fever, anaemia and death	Cattle
Lumpy wool	Fungus	Forms a crust on the skin	**D**

3.2.1 Write down the missing information for **A**, **B**, **C** and **D**.

A

B

C

D

(8)

3.2.2 Identify a disease in the table that affects only dairy cows.

(2)

3.3 Farm business management is a key production factor that makes efficient and effective use of the other three production factors to achieve short-term goals, while ensuring the long-term sustainability of the business.

Name the other THREE production factors excluding management.

(3)

3.4 A vegetable farmer from North-West has projected the income and expenditure for the coming year. The projection estimated income and expenses in order to determine the viability of the business. Expenditure included overhead, fixed and variable costs. The following figures were recorded in the document:

- Sale of vegetables R207 500,00
- Wages of workers R118 400,00
- Loan repayment R19 100,00
- Sale of compost R38 000,00
- Pest control costs R49 222,00
- Other costs R169 322,00

3.4.1 Complete the table (income statement) below using the information provided.

INCOME		**EXPENDITURE**	
TRANSACTION	**AMOUNT**	**TRANSACTION**	**AMOUNT**
TOTAL INCOME		**TOTAL EXPENSES**	

(8)

3.4.2 Use calculations to determine whether the projection of the income and expenditure for the farming business reflects a viable entity or not. Show the formula and all calculations.

(5)

3.4.3 Explain how the following risk management strategies can help this farmer to improve the income of the farm:

(a) On-farm processing or value adding.

(2)

(b) Hedging.

(2)

3.4.4 Define the following terms:

(a) Overhead costs.

(2)

(b) Fixed costs.

(2)

(c) Variable costs.

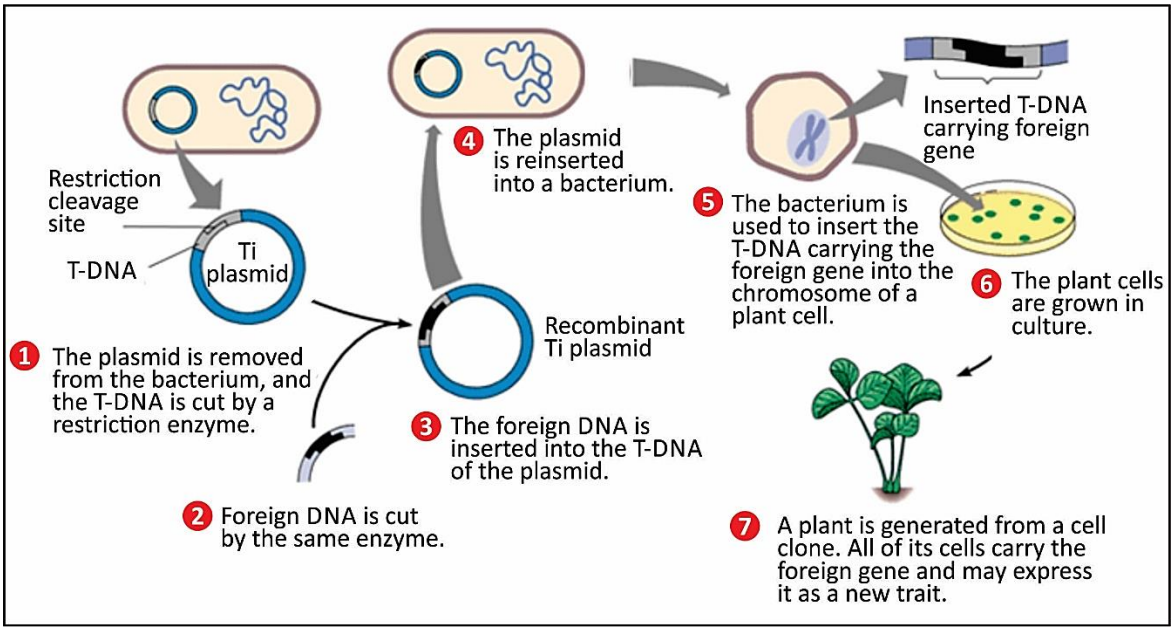
(2)
[50]

QUESTION 4

4.1 Read the following information about genetic modification and answer the questions that follow.

The concept of genetic modification

Genetic engineering is the process of manipulating genes, usually outside an organism's normal reproductive process. The concept includes the use of technology to alter the genetic material of a living cell for agricultural, medical or industrial purposes. Genetic modification is a form of biotechnology that produces a genetically modified organism (GMO). The process involves highly advanced scientific techniques and is normally performed in a highly specialised laboratory. The illustration below shows techniques for genetic modification in plants.



4.1.1 Identify the technique of genetic modification in plants shown above.

(2)

4.1.2 Give TWO other techniques of genetic modification used in plants.

(2)

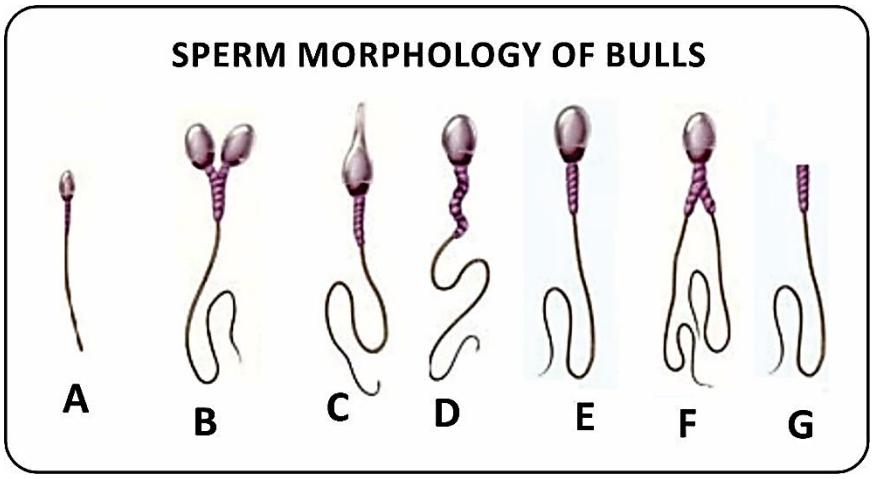
4.1.3 Name TWO aims of genetic modification in plants.

(4)

4.1.4 Differentiate between genetics and heredity.

(4)

4.2 The diagram below illustrates different sperm cells.



4.2.1 Write down the letter (A–G) from the diagram above that represents a sperm cell with normal morphology.

_____

(2)

4.2.2 Name the process by which sperm cells are formed in the male testis.

_____

_____

(2)

4.2.3 Explain how sperm cells **A** and **G** can cause infertility in a bull.

_____

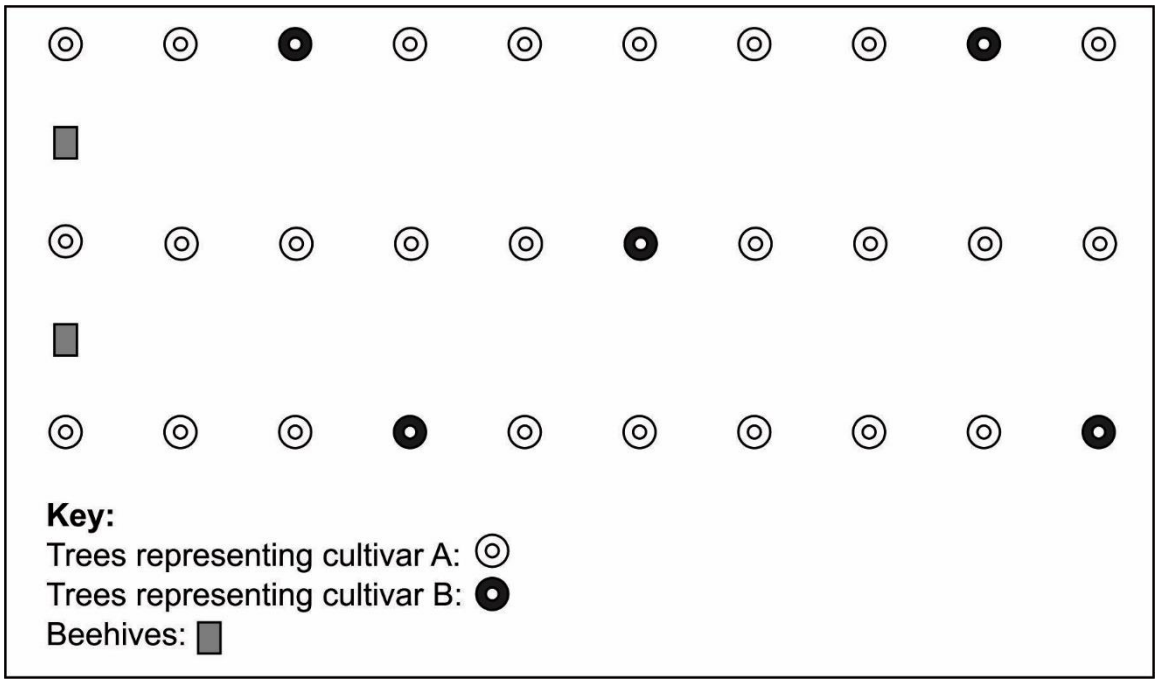
_____

_____

_____

(4)

4.3 A small fruit farmer wants to plant an orchard of plum trees. He learned that the process of cross-pollination is essential for the effective pollination and fruit setting of plum trees. He consulted with many experts and other farmers in the same area. He decided that the long-term marketing prospects for cultivar A would be the most secure. He also aims to plant cultivar B that would not be planted for fruit production (other purpose). He then drew the following sketch plan of his orchard:



4.3.1 Supply a possible reason for the inclusion of cultivar B into this orchard.

(2)

4.3.2 Justify the even distribution or placement of the trees from cultivar B in this orchard.

(2)

4.3.3 Indicate TWO possible reasons for placing beehives in this orchard.

(2)

4.4 DDT is a poisonous chemical that was used in the past as an effective pesticide in agriculture. It was also used by the Department of Health. With the passage of time, it was banned in agriculture because of its disturbance in the ecosystem.

4.4.1 Suggest ONE insect that was controlled by using DDT and is still being controlled to prevent malaria.

_____

(1)

4.4.2 Give TWO characteristics of DDT that might have contributed to it being banned from use in agriculture.

_____

_____

_____

_____

(2)

4.4.3 Mention TWO disadvantages of injudicious use of pesticides in agriculture.

_____

_____

_____

_____

(2)

4.5 The list below represents stages of mating or copulation.

- gaining intromission into the vagina
- ejaculation of semen into vagina
- mounting
- erection of the penis

Re-arrange the stages of mating presented in the list above into its chronological order.

_____

_____

_____

_____

(4)

4.6 A modern farming system makes use of computers, global satellite positioning systems and remote sensing devices to measure the correct environmental conditions and to determine if crops are growing at maximum efficiency. The farming system also uses hi-tech applications such as GPS (Geographic Positioning System) and GIS (Geographic Information System) to identify all possible factors that could have an influence on production.

4.6.1 Identify the farming system described above.

_____

(1)

4.6.2 Justify the use of computers, remote sensing devices and global satellites in a modern farming system with TWO reasons.

_____

_____

(2)

4.6.3 Explain why the following ultra-modern technologies are installed on tractors using the system identified in Question 4.6.1.

(a) Geographic Positioning System (GPS)

_____

_____

(2)

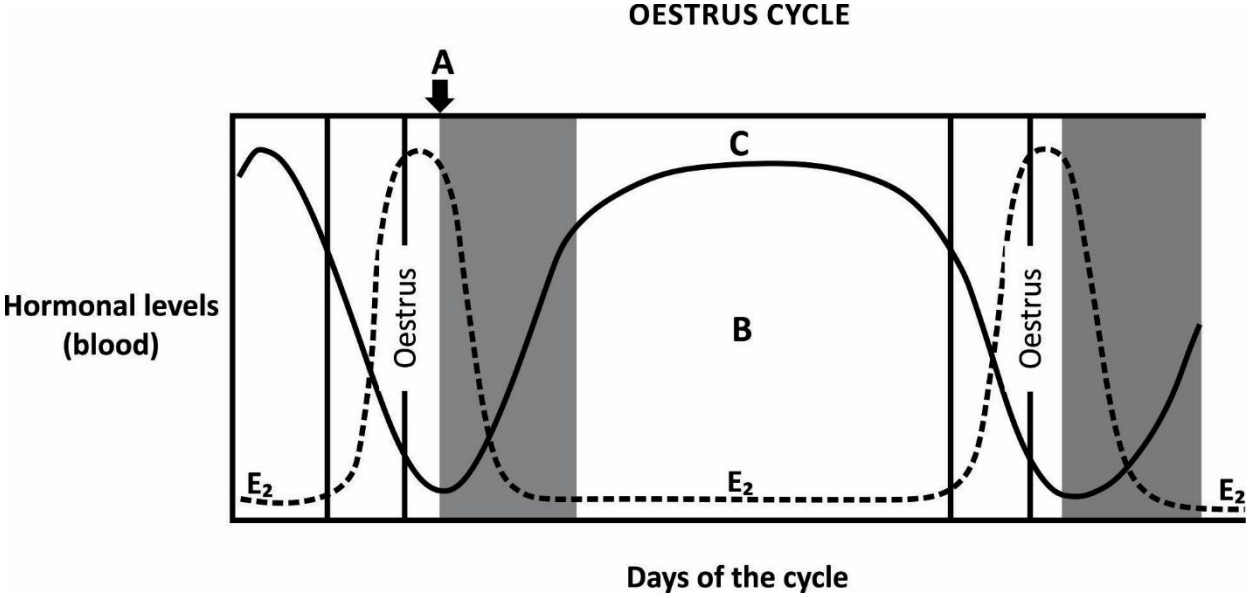
(b) Geographic Information System (GIS)

_____

_____

(2)

4.7 The graph below represents the levels of hormones at different stages in the oestrus cycle of a cow.



4.7.1 Name the hormone labelled **C**.

_____

_____

(2)

4.7.2 Indicate with a reason the stage of the oestrus cycle indicated by the letter **B**.

_____

_____

(2)

4.7.3 Name the process represented by **A** in the graph above.

_____

_____

(2)

4.7.4 Name TWO visible signs of oestrus in a cow.

_____

_____

(2)
[50]

QUESTION 5

5.1 The schematic representation below indicates a cross between a heterozygous black cow with a homozygous recessive white bull. Black (B) is the complete dominant characteristic.

PARENTS (P)			
Phenotype:	Black cow	X	White bull
Genotype:	Unknown	X	Unknown
OFFSPRING (F_1 GENERATION)			
Phenotype:	50% is black and 50% is white		
Genotype:	Unknown		

5.1.1 Identify the genotype of the:

(a) Black parent cow

_____

(2)

(b) White parent bull

_____

(2)

5.1.2 If the group of white heifers in the F_1 generation is crossed with the parent bull, determine the phenotype of the F_2 offspring.

_____

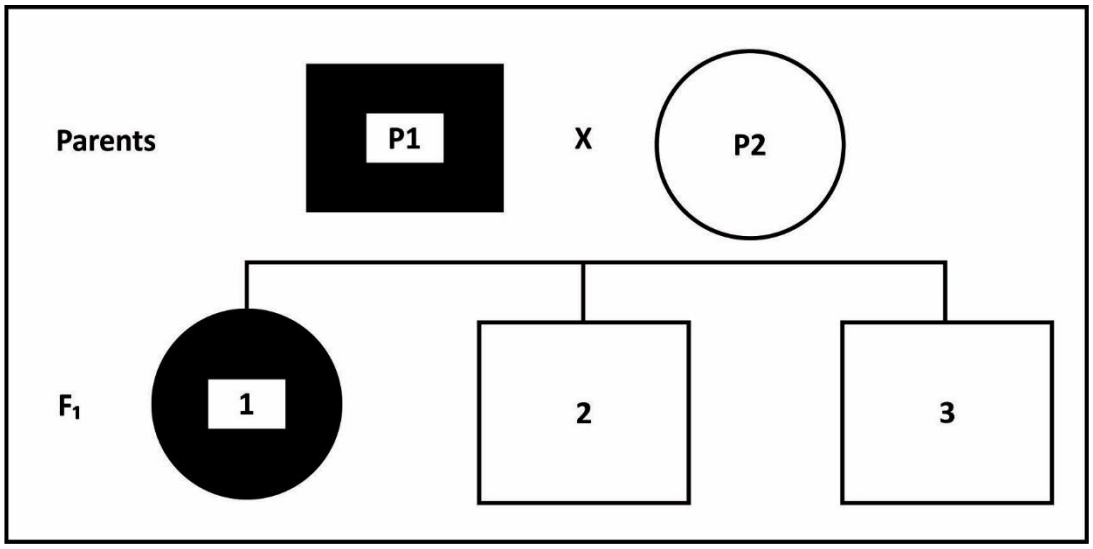
_____

(2)

5.1.3 Use the Punnett square method to illustrate the genotype of the F_1 generation.

(7)

5.2 The schematic representation below illustrates the crossing between parents with different characteristics. Colour is represented by black and white while shape is represented by squares and circles.



5.2.1 Identify the type of crossing illustrated by the representation above.

_____

(1)

5.2.2 Determine the characteristics received by each offspring from parent 1.

Offspring 1: _____

Offspring 2: _____

Offspring 3: _____

(3)

5.2.3 Indicate the characteristics that are dominant in the offspring.

_____

_____

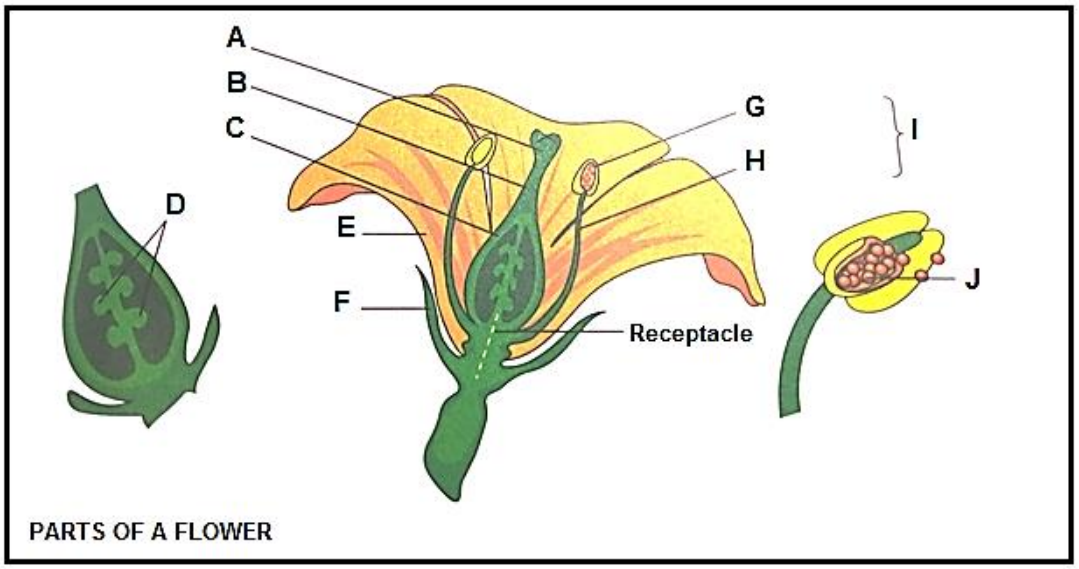
(2)

5.2.4 Name the percentage of genetic material that offspring 2 received from each parent.

_____

(1)

5.3 The picture below shows the flower of a plant.



Match the letter (A–J) of the part of the flower to the functions of the parts of the flower listed below.

5.3.1 Serves as a platform for pollen to fall on during pollination.

_____

(1)

5.3.2 Acts as a tube down which the pollen tube grows when pollen starts to germinate.

_____

(1)

5.3.3 Acts as a male part of the flower.

_____

(1)

5.3.4 Carries the anther in a favourable position for pollination.

_____

(1)

5.3.5 Attracts insects and birds to the flower for pollination and seed dispersal.

_____

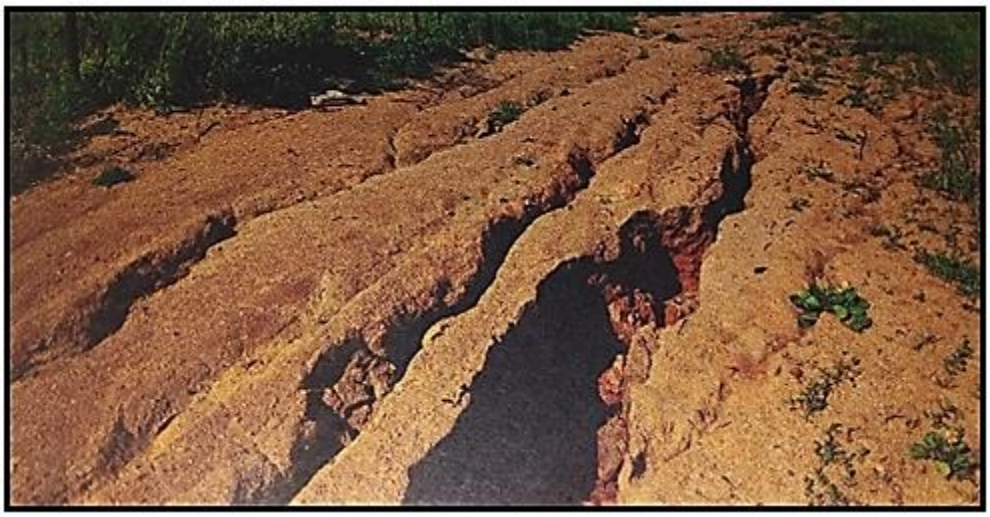
(1)

5.3.6 Produces male cells (pollen grains).

_____

(1)

5.4 Look at the photo below and answer the questions that follow.



5.4.1 Identify the main challenge of the soil seen in the photo above.

_____

(2)

5.4.2 Name TWO physical causes of the challenge identified in Question 5.4.1.

_____

_____

(2)

5.4.3 Explain THREE ways in which the farmer can improve the condition of the soil in the photo on page 33.

_____

_____

_____

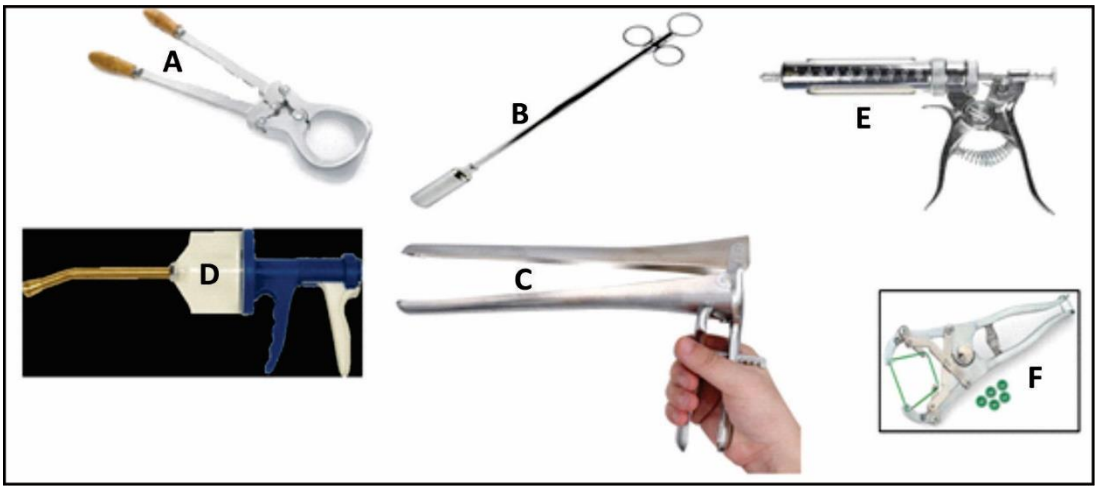
_____

_____

_____

(6)

5.5 Study the equipment shown below and answer the questions that follow.



Match the letter (**A–F**) of the equipment to the function listed below:

5.5.1 Castration of a bull.

_____

(1)

5.5.2 Liquid medicine given to an animal orally.

_____

(1)

5.5.3 Vaccinating farm animals.

_____

(1)

5.5.4 Castrating young animals at an early age.

_____

(1)

5.5.5 Capsules or pills placed in the mouth for swallowing.

_____

(1)

5.5.6 Opening the mouth of an animal.

_____

(1)

5.6 Read the information on breeding systems in agriculture and answer the questions that follow.

Farmer A farms with a cattle breed that produces heavy early weaners. Farmer B farms with a different breed which produces smaller calves that do not grow as fast as those of Farmer A, but are more resistant to local diseases than the cattle of Farmer A.

The old and non-fertile cows are sold to communities to be slaughtered for cultural ceremonies.

Farmer B buys bulls from Farmer A and crosses them with his best heifers. After five years Farmer B realises that his animals are heavier and more fertile than before.

5.6.1 Identify the animal breeding system applied by Farmer B. Substantiate the answer.

(2)

5.6.2 State TWO advantages of outcrossing.

(2)

5.6.3 Give TWO reasons for the selling of old and non-fertile cows.

(2)

5.6.4 Name the breeding system that will be applicable once Farmer B starts using his own outstanding bulls.

_____

_____

(2)
[50]

200 marks

SECTION C

QUESTION 6

Read the passage on artificial insemination below and the statement that follows:

ARTIFICIAL INSEMINATION

Artificial insemination is the technique in which semen with living sperms is collected from the male and introduced into the female reproductive tract at the proper time with the help of instruments. This has been found to result in normal offspring. In this process, the semen is inseminated into the female by placing a portion of it, either in a collected or diluted form, into the cervix or uterus by mechanical methods at the proper time and under the most hygienic conditions. The first scientific research in artificial insemination of domestic animals was performed on dogs in 1780 by the Italian scientist, Lazanno Spalbanzani. His experiments proved that the fertilising power reside in the spermatozoa and not in the liquid portion of semen.

A few further studies under research station conditions helped this technique to be used commercially all over the world. Artificial insemination is not merely a novel method of bringing about impregnation in females, instead, it is a powerful tool mostly employed for livestock improvement. In artificial insemination the germplasm of the bulls of superior quality can be effectively utilised with the least regard for their location in faraway places. By adoption of artificial insemination, there would be considerable reduction in both genital and non-genital diseases in the farm stock.

STATEMENT

One of the main requirements for successful artificial insemination is that the semen must be healthy, viable and disease free. This includes proper storage, thawing and preparation for insemination.

Justify the statement above by discussing the main requirements of artificial insemination (AI) under the following sub-headings:

- The basic requirements for semen collection.
- The methods of collecting semen.
- The characteristics of good quality semen (semen evaluation).
- Dilutants and functions of such dilutants.
- The basic requirements for storage of collected semen.

20 marks

Total: 300 marks

ADDITIONAL SPACE TO ANSWER QUESTIONS. REMEMBER TO CLEARLY INDICATE AT THE QUESTION THAT YOU USED THE ADDITIONAL SPACE TO ENSURE THAT ALL THE ANSWERS ARE MARKED.

