NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2022

AGRICULTURAL SCIENCES

MARKING GUIDELINES

Time: 3 hours 300 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

SECTION A

QUESTION 1

1.1
1.1.1 G
1.1.2 A
1.1.3 B
1.1.4 D
1.1.5 C
1.1.6 E

1.2
1.2.1 Acrosome
1.2.2 Standardisation
1.2.3 Dry/Rest
1.2.4 Atavism/Throwback
1.2.5 Scarification
1.2.6 Genetics

1.3
1.3.1 A 10
1.3.2 B 20
1.3.3 C Loamy Sand
1.3.4 D Silty clay
1.3.5 E 60
1.3.6 F Sandy clay

1.4
1.4.1 Colostrum
1.4.2 Heredity
1.4.3 Cryptorchidism
1.4.4 Hedging
1.4.5 Impotence/Infertility
1.4.6 Biosecurity

1.5
1.5.1 C
1.5.2 B
1.5.3 A
1.5.4 D
1.5.5 A
1.5.6 B

1.6
1.6.1 B
1.6.2 A
1.6.3 D
1.6.4 A
1.6.5 C
1.6.6 D
1.6.7 C
1.6.8 B
1.6.9 A
1.6.10 B

SECTION B

QUESTION 2

2.1 2.1.1 **Vertical cross section showing master horizons**
Soil Profile

2.1.2 **THREE aims of soil surveys in the agriculture industry**
- To determine suitability of soil for agricultural purpose.
- Data obtained on soil, climate and topography is used to determine the type of crop or animal to farm with.
- Soil mapping is used to get reliable data on soils.
- Optimal utilisation of land available.

2.1.3 **Identification of the master horizons**

1: O
2: A
3: E
4: B
5: C
6: R

2.1.4 **TWO main categories of the binomial soil classification systems in South Africa**
- Soil forms
- Soil families

2.1.5 **TWO reasons for classifying of soils in agriculture.**
- To know which crops to cultivate
- To estimate agricultural productivity potential of soils
- How to fertilise the crop correctly
- How to manage irrigation of the crop

2.1.6 **Explanation of the soil survey process in agriculture with steps which need to be followed during soil surveying**
- Aerial photographs of the region are taken and studied (gives preliminary layout, topography, drainage and soil differences)
- Visit of the area for further details such as arable lands, boundaries, fences, roads and buildings (so that these can be indicated on the aerial map)
- Development of preliminary mapping of the land and veld types within the region (land divided into homogenous land and veld types)
- Soil profiles are used for soil classification (soil profiles are studied to distinguish the horizons and identify soil form)
- Morphological properties of each soil horizon are indicated on a soil chart (properties such as soil depth, colour, mottling, structure and consistency)
- Interpretation of all the collected data, so that each hectare of soil is utilised according to its potential

2.2 2.2.1 **Identification of the types of soil degradation**

A: Physical
B: Chemical
C: Biological

2.2.2 **Definition of soil degradation**
Soil degradation is the loss in the productive potential of soil as a result of human activities

2.2.3 **Explanation of how soil degradation can be a threat to agricultural productivity**

- Food security will be affected negatively
- Reduced productivity of the land costs the farmer huge amounts of money
- The eroded soil ends up in rivers, which leads to siltation problems and less water stored

2.3 2.3.1 **Identification of a farming system**
Precision farming

2.3.2 **Identification of piece of equipment**
Computers

2.3.3 **THREE basic principle aims of precision farming**

- Optimal production (best production with least input costs possible)
- Less damage to the environment
- Sustainability of production
- Healthier food for all with less fertilisers and pesticides

2.3.4 **Meaning of the acronyms:**

(a) **GPS:** Geographic Positioning Systems
(b) **GIS:** Geographic Information Systems

2.3.5 **Explain the purpose of farmers using the following special equipment on their tractors**

(a) **GPS:** Farmers use a GPS that provides precise time and location information to the farmer to make informed decisions

(b) **GIS:** Contains computer software database system used to input, store, retrieve, analyse and display the data in a map form

QUESTION 3

3.1

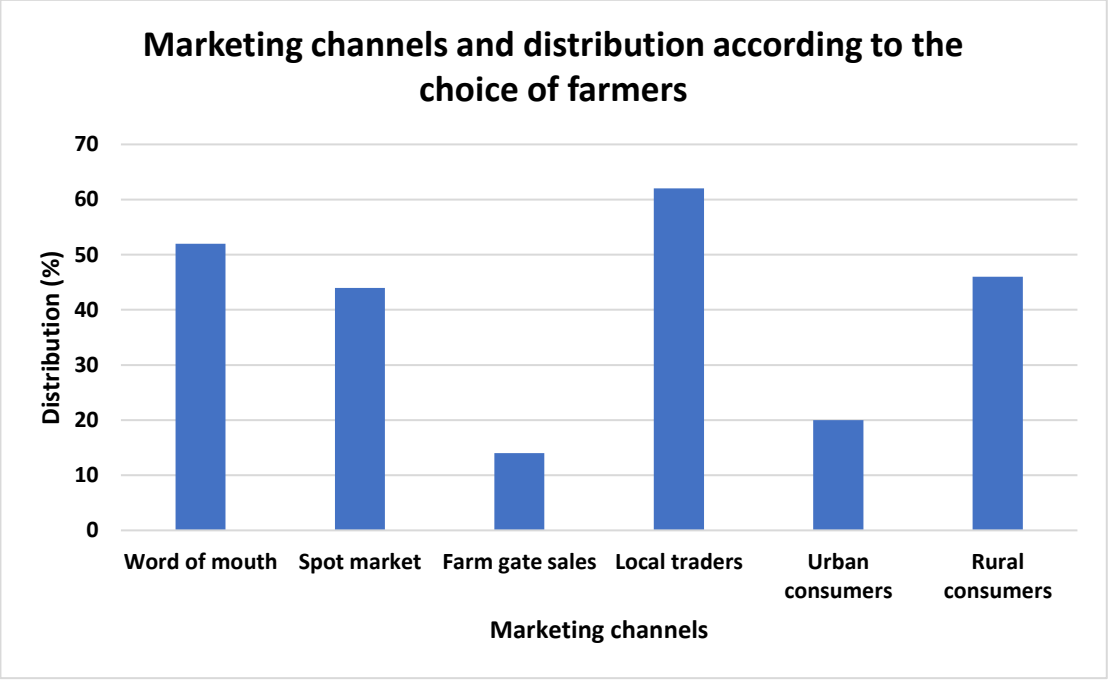
Marketing channels	Distribution (%)
Word of mouth	52
Spot markets	44
Farm gate sales	14
Local traders	62
Urban consumers	20
Rural consumers	46

3.1.1 **Identification of the type of marketing system**
Free marketing

3.1.2 **THREE visible reasons on the picture to support the answer**

- No middlemen/intermediaries / No commission
- Selling freely to the public
- Consumers bargaining
- Better quality products for consumers

3.1.3 **Graph**



Criteria/rubric/marking guidelines

- Correct heading
- X-axis: Correctly calibrated
- X-axis: Correct label (Marketing channels)
- Y-axis: Correctly calibrated
- Y-axis: Correct label (Distribution)
- Correct unit (%)
- Correct type of graph (Bar graph)
- Correct plotting of bars
  - Less than 2 bars incorrect : No mark
  - 2 bars plotted correctly : 1 mark
  - 4 bars plotted correctly : 2 marks
  - 6 bars plotted correctly : 3 marks

3.1.4 **THREE differences between selling and marketing**

Selling	**Marketing**
Emphasis on product	Emphasis on customer wants
Farm produces and decides on how to sell	Determine customer wants and decide on how to produce and deliver
Sales volume orientated	Management is profit orientated
Short term planning for current sales	Long-term planning for future
Focuses on needs of seller	Focuses on wants of buyers

3.1.5 **4-Ps of marketing**

- Product
- Placement
- Price
- Promotion

3.1.6 **THREE approaches to marketing**

- Market segmentation
- Niche marketing
- Mass marketing
- Multi-segment marketing

3.2 **Table**

A: Foot and Mouth Disease (FMD)
B: Bacteria
C: Coccidiosis
D: Fungi

3.3 3.3.1 **Name of the disease**
Rift Valley Fever (RVF)

3.3.2 **Identification**

(a) **Vector**: Mosquito
(b) **Pathogen**: Virus

3.3.3 **Extract from the scenario**
If a farmer suspects that some animals are infected, authorities should be alerted immediately

3.3.4 **THREE economic implications of animal diseases to the farmer**
- Banning of exports and imports/ Decrease in international trade
- Negative impact on food security
- Decreased production/ loss of income
- High treatment/vaccination costs to control/prevent diseases

3.4 3.4.1 **Identification of the main group of internal parasites**
Liver fluke

3.4.2 **The intermediate host**
Snail/Slugs

3.4.3 **TWO other main groups of internal parasites**
- Tapeworms
- Roundworms

3.4.4 **THREE pasture management measures to control the parasite**
- Practice rotational grazing
- Resting of the infected pastures to break the cycle
- Veld/pasture burning
- Avoid grazing animals on wet places
- Use of zero grazing
- Application of hygienic measures/removal of manure
- Breeding/selecting more resistant animals

QUESTION 4

4.1 4.1.1 **Identification of the reproductive process represented by C**
Double fertilisation

4.1.2 **Definition of double fertilisation**
The process where one sperm fertilising the egg cell and the other sperm combining with the two polar nuclei on a large central cell of the embryo sac

4.1.3 **Difference between vegetative and stimulative parthenorcarpy**
Stimulative parthenorcarpy is when some stimulation is needed for parthenorcarpy to occur
Vegetative parthenorcarpy is where no stimulation is required for plants to produce parthenorcarpic fruit

4.2 **The diagrams showing a method of artificial plant propagation.**

4.2.1 **Identification of the type of plant propagation**
Grafting

4.2.2 **Labels for A and B**

A: Scion
B: Rootstock

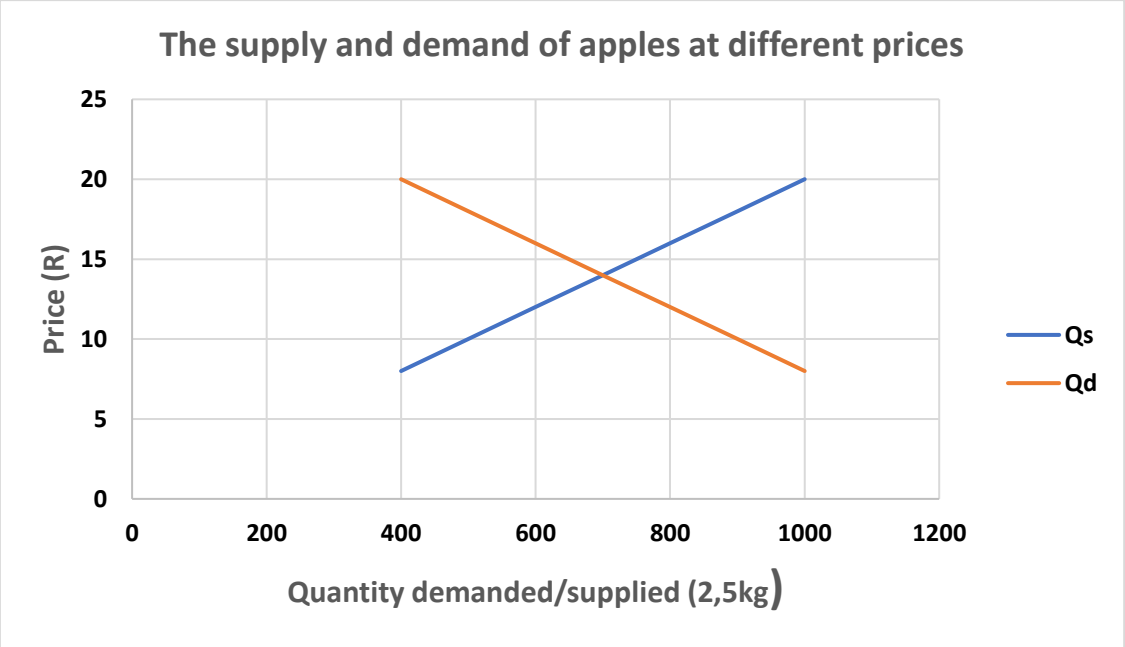
4.2.3 **TWO advantages of the plant propagation method**

- Production of several fruit varieties on the same tree
- Fruit bearing quality can be improved by grafting
- Production of plants with different flower colours on the same plant
- The appearance of the plant can be changed
- An undesirable trait can be corrected
- Scion can be grafted onto a better healthier rootstock with more vigorous root system

4.2.4 **TWO examples of fruit trees propagated in South Africa using grafting**

- Lemon
- Oranges
- Naartjies
- Lime
- Grapefruit

4.3 4.3.1 **Demand and supply curves**



Criteria/rubric/marking guidelines

- Correct heading
- X-axis: Correctly calibrated (Scale)
- X-axis: Correct label (Quantity demanded/supplied)
- Y-axis: Correctly calibrated (Scale)
- Y-axis: Correct label (Price)
- Correct unit (R/2,5 kg)
- Correct type of graph (line graph)
- Correct plotting of bars

4.3.2 **Equilibrium price**
R14,00

4.4 4.4.1 **Name of the phenomenon**
Ablactation

4.4.2 **Biological cause of ablactation**
Inadequate pollination

4.4.3 **TWO climatic factors that can lead to ablactation**

- Low or cold temperatures
- Frost
- Excessive rain or moisture
- Wind

4.5 4.5.1 **Matching statement with pieces of legislation**

(a) **Occupational Health and Safety Act (Act 85 of 1993)**
- Supply of protective gear
- Provision of training to employees

(b) **Basic Conditions of Employment Act (Act 75 of 1997)**
- Wages/Salaries
- Conditions for termination of service

(c) **Labour Relations Act (Act 66 of 1995)**
- Affiliation to trade unions and right to strike
- Dispute between employer and employee

4.5.2 **TWO benefits of the Unemployment Insurance Fund for farm workers.**
- Unemployment Allowance is provided to workers losing their jobs under no fault of their own/Replacing some lost income
- Provide additional support to workers during recessions
- Unemployment benefits help keep them out of poverty

4.6 4.6.1

TYPES OF CAPITAL	EXAMPLE	SOURCE OF CAPITAL
Fixed	A dam / Irrigation system	Bank loan
Movable	Bakkies / Beef cattle	Inheritance

4.7 4.7.1 **Type of cross indicated in the Punnett square**
Dihybrid cross / Dihybridism

4.7.2 **Genotype for:**
- **Offspring 1:** RRYY
- **Offspring 2:** rryy

4.7.3 **Phenotypic ratio of the cross**
9:3:3:1

4.8 4.8.1 **Identification of the breeding method**
Cross breeding

4.8.2 **TWO benefits of cross breeding for Farmer B**
- Offspring are hybrids/heterozygous
- Improved traits because dominant genes mask unwanted recessive genes
- Can be used to change local breeds

QUESTION 5

5.1 5.1.1 **Identification of the financial record**
Balance sheet

5.1.2 **The purpose of a balance sheet**
Is to give interested parties an idea of the company's financial position, in addition to displaying what the company owns and owes

5.1.3 **Values for:**

A: R4850 000
B: R1035 000

5.1.4 **Calculation: Net worth of ABC Farm Business**
Net worth = Value of Assets – Value of Liabilities
= R4 850 000 – R1 035 000
= R3 815 000

5.1.5 **Percentage of current assets to the value of total assets**

$$\frac{\text{R962 000}}{\text{R4 850 000}} \times 100 = 19,8\%$$

5.2 5.2.1 **Classification of the factors of production**

A: Labour
B: Management/Entrepreneurship
C: Land
D: Capital

5.2.2 **TWO economic functions of the land**
- It is an asset
- It provides space
- It provides food for people and animals
- It is a source of minerals
- It provides raw materials
- Serves as measure for wealth

5.2.3 **TWO problems associated with labour in agriculture**
- Lack of skills/training/unskilled labour
- Labour shortages/scarcity
- Diseases (e.g. HIV/AIDS, COVID-19)
- Labour unrest/worker's rights
- Economic migrants
- Social problems
- Safety at work in enterprises such as game ranching
- Competition from industries

5.2.4 **TWO problems associated with capital**

- Scarcity
- Expensive / High costs
- Risk
- Law of diminishing returns
- Overcapitalisation
- Undercapitalisation
- Depreciation

5.3 **Table**

	Organ / process / condition	**Bull**	**cow**
5.3.1	Organ where gametes are produced	Testis	Ovaries
5.3.2	Name of the gamete produced	Sperm cell	Egg cell / Ovum
5.3.3	The process by which gametes are formed	Spermatogenesis	Oogenesis / Ovigenesis

5.4 5.4.1 **Rearranging artificial insemination steps chronologically**

- Semen harvesting
- Semen examination
- Semen dilution
- Heat detection
- Placing semen into the reproductive tract of a cow

5.4.2 **TWO advantages of artificial insemination for the farmer**

- Superior male animals can fertilise more females
- Quick and economical way to improve the herd/no need for an expensive bull
- Decreases exchange of STDs
- Semen of males in other countries can be used/reduces inbreeding
- Valuable tool for progeny testing

5.5 5.5.1 **Identification of the process**
Nuclear Transfer/Cloning

5.5.2 **The sheep that will be genetically identical to the sheep labelled D**
Sheep A

5.5.3 **The letter of the sheep that will serve as a surrogate**
Sheep E

5.5.4 **The name of the process labelled C**
Enucleation

5.5.5 **TWO aims of cloning**

- To produce large numbers of genetically identical animals (clones)
- To produce offspring from high-quality animal
- To preserve and extend proven, superior genetics
- To achieve production of high-quality meat and dairy products
- To increase the number of endangered species

5.6 5.6.1 (a) **Foetus lies on its abdomen with forefeet stretching towards the pelvis and the head resting on it.**
Anterior presentation

(b) **Rear part of the foetus lies towards the cervix resulting in hind legs appearing first.**
Posterior presentation

5.6.2 **The term for difficult birth**
Dystocia

5.6.3 **TWO problems other than presentation causing difficult birth.**

- Cows with multiple births
- Malformed foetus
- Calves with high birth weight
- Age of cow
- Size of pelvic area
- Cervix that does not dilate/hormonal disturbances
- Torsion of uterus
- Weak labour/length of gestation
- Diseases
- Retained placenta
- Prolapse of uterus

SECTION C

QUESTION 6

Discuss biotechnology in agriculture under the following sub-headings:

- The concept of biotechnology
- The characteristics of genetically modified crops
- Examples of genetically modified crops in South Africa
- The advantages of genetically modified crops
- The disadvantages of genetically modified crops

Biotechnology in agriculture

The concept: biotechnology

- The exploitation of biological processes for industrial and other purposes, especially the genetic manipulation of microorganisms for the production of antibiotics, hormones, etc.

- Biotechnology is technology that utilises biological systems, living organisms or parts of this to develop or create different products.

- Biotechnology is the integration of natural sciences and engineering sciences in order to achieve the application of organisms, cells, parts thereof and molecular analogues for products and services.

The characteristics of GMOs

Genetically modified organisms (GMOs) can be defined as organisms (i.e. plants, animals or microorganisms) in which the genetic material (DNA) has been altered in a way that does not occur naturally by mating and/or natural recombination. The technology is often called 'modern biotechnology' or 'gene technology', sometimes also 'recombinant DNA technology' or 'genetic engineering'. It allows selected individual genes to be transferred from one organism into another, also between nonrelated species. Foods produced from or using GM organisms are often referred to as GM foods.

Examples of genetically modified crops in South Africa

Currently South Africa grows three commercial crops that have been genetically modified, mainly for herbicide and insect tolerance.

Three examples are:
1. Maize
2. Cotton
3. Soya

However, Biowatch South Africa, an organisation interested in food security and biosafety in the country, reports that field trials have been carried out on genetically modified potatoes, wheat, canola, sugarcane, apple, eucalyptus, strawberry, sugar beet, tomato and sweet potato.

The advantages of genetically modified crops/plants (GMOs)

1. It allows for more profit.
   GMOs are an effective way to provide farmers with a larger profit, while spending less on resources.

2. It introduces the knowledge of genetic alterations.
   This is done through mapping genetic material for GMO crops. This way, we would get the ability to enhance crop genes and make them more beneficial for human production and consumption. Plants can be engineered to resist unfavourable temperature or produce higher yields, which is good for regions where climate limits productivity.

3. It is economically efficient.
   Because GMOs are designed to resist pests, there will be no need for pesticides to be used, which means more savings.

4. It is known to decrease food prices.
   Advanced crops and lower costs can lead to cheaper food. This will certainly help families who cannot afford to buy their needed supply for everyday consumption, so starvation will be prevented.

5. It adds more nutritional value to crops.
   The GMO method can put in added nutritional value to crops that lack necessary vitamins and minerals. Considering that there are places in the world relying on rice or corn as their daily staple, plant genes may be added to these crops to increase their nutritional value. This would help malnourished populations receive more nutrients from their diet.

6. Its products are found to be safe.
   The precise evaluation and testing of GM crops and other products means they are safe for human consumption. In fact, research shows that they are safer compared with traditional crops.

7. It is tastier

8. Disease- and drought-resistant plants that require fewer environmental resources (such as water and fertiliser)

9. Increased supply of food with reduced cost and longer shelf life

10. Faster growing plants and animals

11. Food with more desirable traits, such as potatoes that produce less of a cancer-causing substance when fried

12. Medicinal foods that could be used as vaccines or other medicines

The disadvantages of genetically modified crops/plants (GMOs)

1. Allergic Reactions
   In humans, the number one most common side effect of consuming GM foods is allergic reaction. This allergic reaction happens when a certain protein/allergen present in the GM crop enters the body and stimulates an immune response. This process is considered to have adverse effects on humans because these inserted genes may carry specific allergens that trigger such an immune response.

2. Production of toxins
   GM food may also increase its production of toxins at levels already harmful to humans. Such may result from toxins produced when there is damage in the 'Gene of Interest' during the insertion process. Another reason is when the inserted gene is not generally accepted by the recipient organism because it interferes with its metabolic pathway. Thus, by eating such foods with toxins, the possibility of ingesting the toxin and being harmed by it may happen.

3. Reduced nutritional value
   Ironically, some genetically modified foods have been reported to be void of nutritional value. As genetic engineering tends to focus more on increasing their production, prolonging their lifespan, and deterring pests, the nutritional value of some crops is sometimes compromised. In a study published in the journal Food Chemistry, it has been found that organic soybeans are far higher in nutritional components like healthy sugar, proteins, selenium, and zinc, compared to genetically modified soybeans.

4. Release of toxins to soil
   The disadvantages of GM crops are much larger than simply harming our health. Regarding its environmental effects, toxicity is a huge issue concerning GM crops. One particular example is the Bt Corn (Bacillus Thuringensis Corn), which is widely known for its pest-controlling ability. Bacillus thuringensis is a soil bacterium that has a gene that produces certain protein toxins that effectively destroy pests and insects, like larval caterpillars. This gene is then inserted into the corn to make it more resistant to pests. While such characteristic helps control pests, this may result in releasing the said toxin into the soil. Too many toxins in the soil can prevent the growth of bacteria essential for plant growth. As a result, the soil becomes void of all necessary nutrients.

5. Resistance of pests to toxins
   The long-term effects of GMOs are not certain. Scientists fear that excessive production of genetically modified foods with toxin-producing properties will be rendered ineffective over time. This is because the pests that these toxins used to deter might eventually develop resistance towards them.

6. Disruption of biodiversity
   The production of GM foods imposes high risks to the disruption of biodiversity. This is because the 'better' traits produced from engineering genes can favour one organism. Furthermore, the introduction of genetically modified organisms can eventually disrupt the natural process of gene flow. Disrupted gene flow can also lead to these genetically modified crops becoming weeds because they breed so rapidly and out-compete other crops.

Total: 300 marks