

# AGRICULTURAL SCIENCES

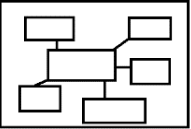



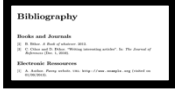

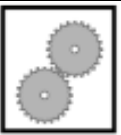

2025 SPRING SCHOOL AND LAST PUSH

GRADE 12

## GUIDE FOR TEACHERS AND LEARNERS






## ICON DESCRIPTION

 <b>MIND MAP</b>	 <b>EXAMINATION GUIDELINE</b>	 <b>CONTENTS</b>	 <b>ACTIVITIES</b>
 <b>BIBLIOGRAPHY</b>	 <b>TERMINOLOGY</b>	 <b>WORKED EXAMPLES</b>	 <b>STEPS</b>

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<b>TOPIC 1: ANIMAL NUTRITION</b>	
<b>UNIT 1: THE STRUCTURE OF ALIMENTARY CANAL</b>	
<b>EXAMINATION GUIDELINE AND OUTCOME</b>	
<ul style="list-style-type: none"><li>● Compare the external structure of the alimentary canal of a ruminant (cow and sheep) and a non-ruminant (fowl and pig)</li><li>● Functions and adaptations of various structures of the alimentary canal</li><li>● Description of the internal structure of the rumen, reticulum, omasum, abomasum and small intestines</li></ul>	
<b>UNIT 2: DIGESTION IN RUMINANTS AND NON-RUMINANTS</b>	
<b>EXAMINATION GUIDELINE AND OUTCOME</b>	
<b>Digestion in non-ruminants</b> <ul style="list-style-type: none"><li>● A brief explanation of the intake of feed</li><li>● The mechanical and/or chemical (enzymes) digestion processes in the mouth, stomach, small intestine and the large intestine</li><li>● Functions of the salivary glands, the liver, pancreas and intestinal glands (accessory glands)</li></ul>	
<b>Digestion in ruminants</b> <ul style="list-style-type: none"><li>● Definitions of rumination, regurgitation and peristalsis</li></ul>	
<ul style="list-style-type: none"><li>● Explanation of the intake of food and the chewing of the cud (swallowing and re-swallowing)</li></ul>	
<ul style="list-style-type: none"><li>● The differences in size and functionality of the four stomach compartments of a mature ruminant compared to a young ruminant</li></ul>	
<b>Digestion in the rumen</b> <ul style="list-style-type: none"><li>● Describe rumen microbes as single-celled organisms found in the reticulorumen</li><li>● Briefly classify the different types of rumen microbes</li><li>● Specific functions of different bacteria (cellulytic, proteolytic, amylolytic)</li><li>● Describe the most important requirements for normal functioning of rumen microbes/microorganisms</li><li>● Name the functions of the rumen microbes</li><li>● Explain the direct absorption of food in the rumen and small intestine directly by osmosis, diffusion and active transport into the blood stream</li></ul>	
<b>UNIT 3: TYPES OF FEED</b>	
<b>EXAMINATION GUIDELINE AND OUTCOME</b>	
<ul style="list-style-type: none"><li>● Illustrate the basic classification of animal feeds</li><li>● Define roughages and concentrates</li></ul>	
<ul style="list-style-type: none"><li>● Describe the different types of roughages and concentrates</li></ul>	
<ul style="list-style-type: none"><li>● Make a schematic representation of different types of animal feeds</li></ul>	
<ul style="list-style-type: none"><li>● Importance of roughage and concentrates as feeds for different types of animals (ruminants and non-ruminants)</li></ul>	
<b>UNIT 4: DIGESTIBILITY AND QUALITY OF FEED</b>	
<b>EXAMINATION GUIDELINE AND OUTCOME</b>	
<b>Digestibility of feeds</b>	
<ul style="list-style-type: none"><li>● Define the digestibility and digestibility coefficient of feeds</li></ul>	
<ul style="list-style-type: none"><li>● Understand the different steps in the calculation of digestibility coefficient, interpretation and implication of calculated values</li></ul>	
<b>Quality of feed: biological value of proteins</b>	
<ul style="list-style-type: none"><li>● Define the concepts: biological value (BV), essential amino-acid index and ideal proteins</li></ul>	
<ul style="list-style-type: none"><li>● Explain the importance of animal proteins in rations</li></ul>	
<ul style="list-style-type: none"><li>● Evaluate a feed protein in terms of biological value (egg protein and milk protein)</li></ul>	
<b>Energy value of feed</b>	
<ul style="list-style-type: none"><li>● Name the units in which energy value is expressed</li></ul>	
<ul style="list-style-type: none"><li>● Define and outline gross energy, metabolic energy, digestible and net energy</li></ul>	

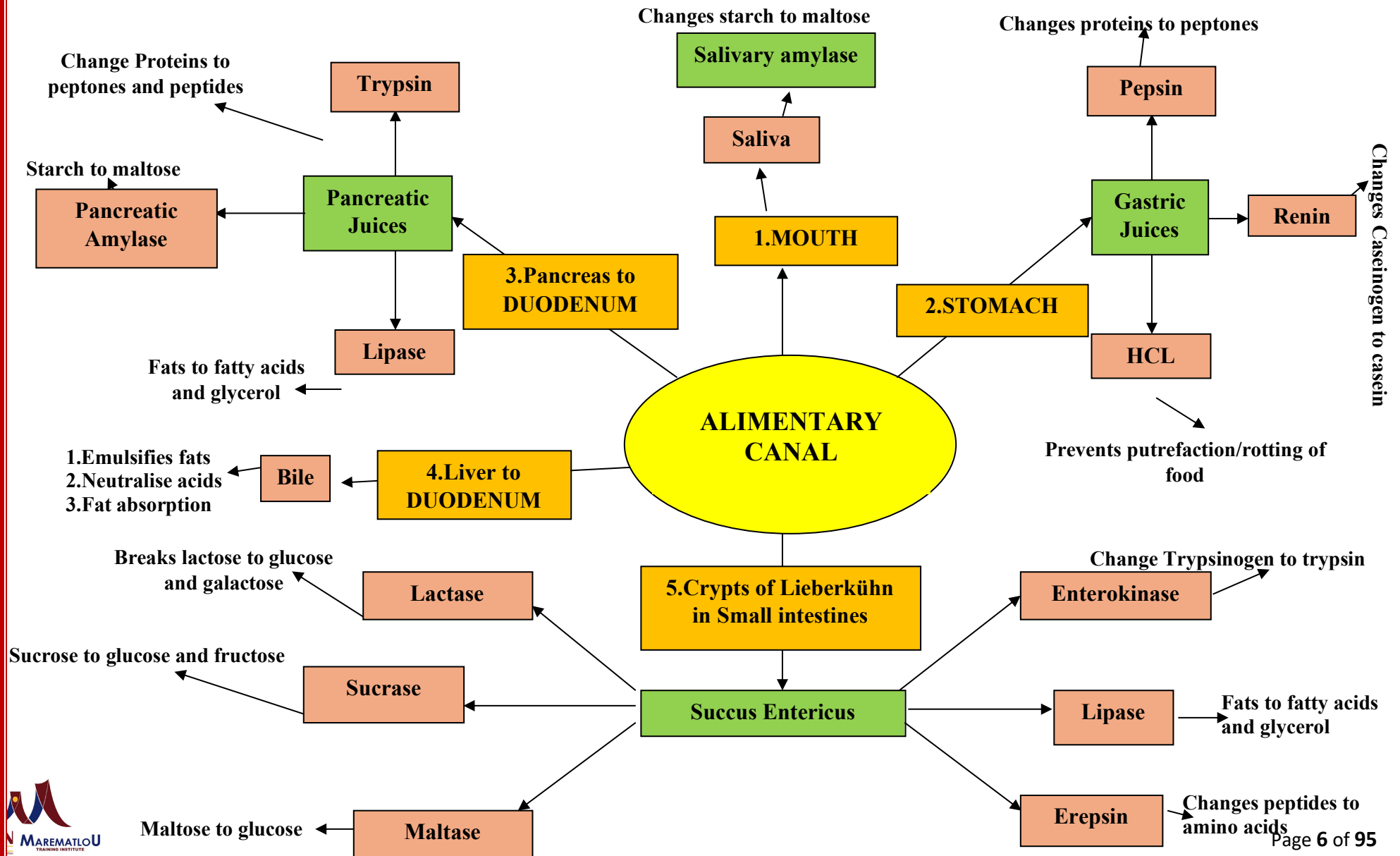
●	Describe the purpose/aims of calculating energy value of the feed
●	Identify and draw a schematic representation of feed energy flow
●	Use formulae to calculate the feed energy flow and interpret the results
<b>Nutritive ratio</b>	
●	Define the concept of nutritive ratio (NR)
●	Describe the purpose/aims of the nutritive ratio in animal feeding
●	Use different formulae to calculate and interpret the nutritive value of a feed
<b>Pearson square</b>	
●	A brief overview of the Pearson square method (feed formulation)
●	Calculate and draw the feed requirements using a single Pearson square method
●	Interpret the Pearson square results for feed mixtures
●	Conversion of the feed ratios into kilograms and percentages



## ALIMENTARY CANALS

Alimentary canal	Pig	Cattle/sheep	Fowl
1. Mouth Teeth	<ul style="list-style-type: none"> <li>Thick upper lip &amp; snout</li> <li>All four kinds of teeth                             <ul style="list-style-type: none"> <li>Incisors: 4 in each jaw</li> <li>Canines: two in each jaw</li> <li>Premolars: 8 in each jaw</li> <li>Molars: 6 in each jaw</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Broad thick lips hardly moveable</li> <li>Two kinds of teeth                             <ul style="list-style-type: none"> <li>No incisors in upper jaw, 8 in lower jaw</li> <li>No canine teeth</li> <li>Premolars: 6 in upper, 6 lower jaw</li> <li>Molars: 6 in upper, 6 in lower jaw</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>No lips, but a horny beak</li> <li>No teeth</li> </ul>
Tongue	<ul style="list-style-type: none"> <li>Long, narrow, muscular, ends in a thin point</li> </ul>	<ul style="list-style-type: none"> <li>Very movable, long and muscular, very rough surface</li> </ul>	<ul style="list-style-type: none"> <li>Narrow, pointed, hardly any muscular tube</li> </ul>
2. Pharynx	<ul style="list-style-type: none"> <li>Muscular tube 30 – 40 mm long</li> </ul>	<ul style="list-style-type: none"> <li>Longer and wider than in pig</li> </ul>	<ul style="list-style-type: none"> <li>Very short tube</li> </ul>
3. Oesophagus	<ul style="list-style-type: none"> <li>Long narrow tube</li> </ul>	<ul style="list-style-type: none"> <li>Same as in pig but longer approximately 1m.</li> </ul>	<ul style="list-style-type: none"> <li>Dilates to form a bag-like enlargement - crop</li> </ul>
4. Stomach	<ul style="list-style-type: none"> <li>Simple stomach and consist of                             <ul style="list-style-type: none"> <li>Cardiac sphincter</li> <li>Cardiac ,Fundus, Pyloric</li> <li>Pyloric sphincter</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Compound stomach and consist of                             <div style="display: inline-block; vertical-align: middle;"> <ul style="list-style-type: none"> <li>Rumen</li> <li>Reticulum</li> <li>Omasum</li> <li>Abomasum – True stomach</li> </ul> </div> <span style="font-size: 2em; vertical-align: middle;">}</span> <span style="display: inline-block; vertical-align: middle;">Forestomachs</span> </li> </ul>	<ul style="list-style-type: none"> <li>Gastric complex consists of                             <ul style="list-style-type: none"> <li>Proventriculus (glandular)</li> <li>Ventriculus /Gizzard(muscular)</li> </ul> </li> </ul>
5. Small intestines	<ul style="list-style-type: none"> <li>Very long narrow tube (approx. 15 m). Divided into:                             <ul style="list-style-type: none"> <li>Duodenum, Jejunum, Ileum</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Same as pig but much longer approximately 45 m long</li> </ul>	<ul style="list-style-type: none"> <li>Same as pig but much shorter and small</li> </ul>
6. Large intestines	<ul style="list-style-type: none"> <li>Shorter but much wider</li> <li>Divided into caecum, colon, and rectum</li> <li>Portion of the colon is sacculated</li> </ul>	<ul style="list-style-type: none"> <li>Colon not as wide as in the pig and also not sacculated</li> </ul>	<ul style="list-style-type: none"> <li>Two caeca, No colon</li> <li>Short rectum</li> <li><b>Cloaca</b> in which both alimentary and uro-genital openings end</li> </ul>
7. Anus	<ul style="list-style-type: none"> <li>External opening for defaecation</li> </ul>	<ul style="list-style-type: none"> <li>Same as in pig</li> </ul>	<ul style="list-style-type: none"> <li>External opening for defaecation and urination called the <b>vent</b>.</li> </ul>

## SUMMARY OF THE PRINCIPAL DIGESTIVE ENZYMES



# CHEMICAL / ENZYMATIC DIGESTION MIND MAP

- No digestive juices are secreted here.
- Only water absorption

## LARGE INTESTINES

## CHEMICAL DIGESTION

### 1.MOUTH:

- Salivary amylase / ptyalin

- Breaks down starch to maltose

### 2.STOMACH:

- Gastric juices

#### Hydrochloric acid

- Activates pepsinogen to pepsin
- Neutralise alkaline reaction of saliva
- Supplies acid medium required by rennin and pepsin
- Changes sucrose to glucose
- Antiseptic /kills bacteria and prevents

#### Rennin

- Causes milk to curdle by changing soluble caseinogen to insoluble casein

#### Pepsin

- Reacts on proteins and digest them into peptones

#### a. Protein

- Trypsin & chemotrypsin
- Changes proteins to peptones

#### b. Lipid digestion

- Pancreatic lipase - changes lipids to fatty acids and glycerol

#### c. Carbohydrate

- Pancreatic amylase - changes starch into maltose

Pancreatic juices

### 3.SMALL INTESTINES: - succus entericus

Maltase – changes Maltose to glucose

Peptidase – changes peptides to amino acids

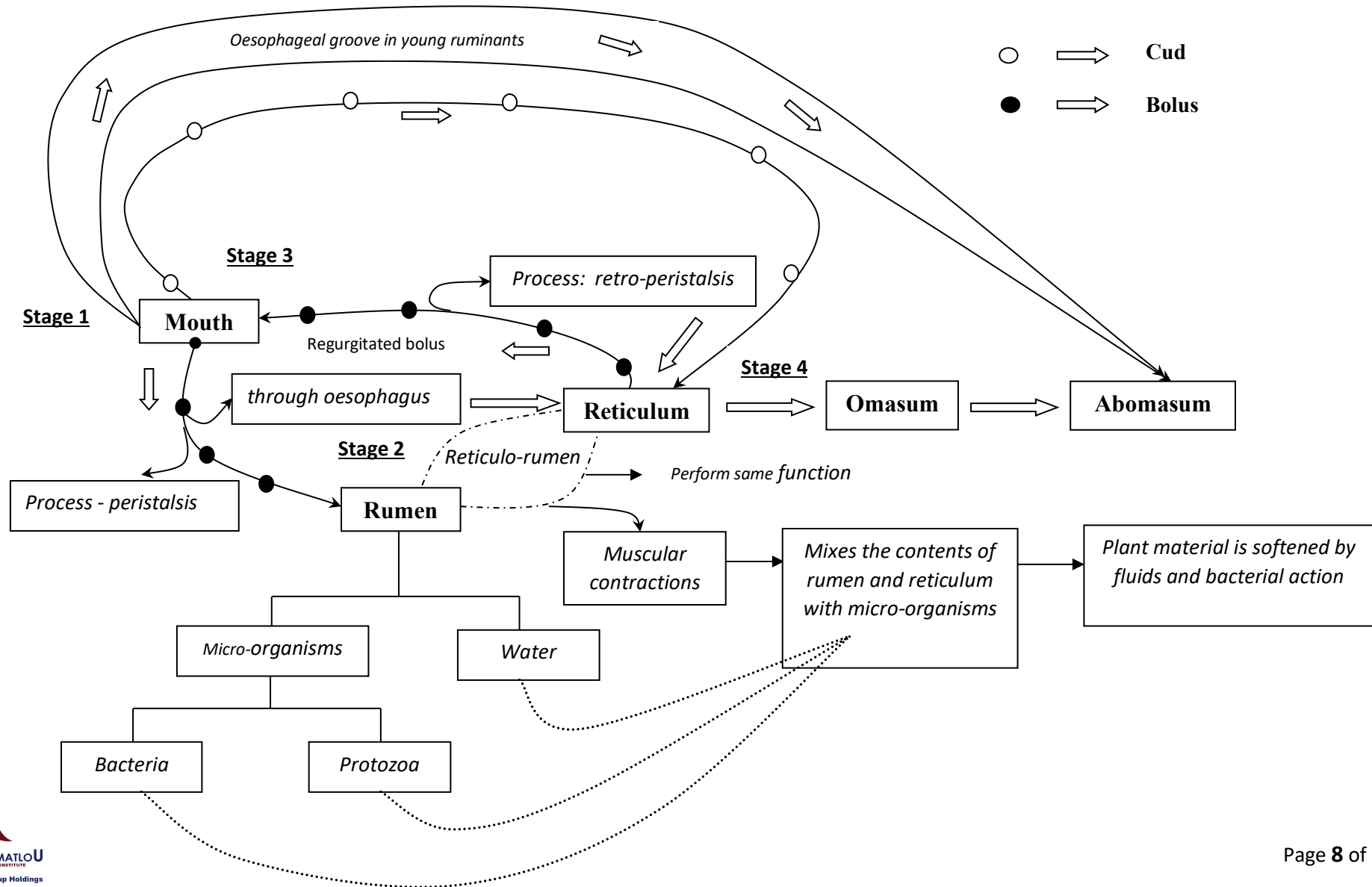
Sucrase – changes sucrose to glucose & fructose

Lipase – changes fats to glycerol & fatty acids

Lactase – changes lactose to down glucose and galactose

Enterokinase activates trypsinogen to trypsin

## ROUTE OF THE FOOD AND CHEWING THE CUD (RUMINATION)



**1. DIFFUSION:** Diffusion is a process whereby a gas or a substance in solution spreads from areas of high concentration to areas of low

**2. OSMOSIS:** is the passage of solvent /water molecules across a semi-permeable membrane from high to low concentration.

### **3. ACTIVE TRANSPORT:**

This is a process where molecules move against concentration gradients (from low to high conce..).

Such movement in contrast to diffusion and osmosis **requires energy**. (from ATP).

Proteins called **carrier molecules** bind the

## **MIND MAP ABSORPTION IN THE RUMEN AND LOWER PARTS OF ALIMENTARY CANAL**

### **7. Absorption in the large intestines:**

- Mainly water, but also some free fatty acids produced by micro-organisms.
- Products of fermentation and amino acids are absorbed in the colon

### **6. The absorption in small intestines (cont):**

*(Absorption by capillary blood vessels in the villi)*

- Water, amino acids, glucose, vitamins and mineral salts

*(Absorption by the central lymphatic system in the villi)*

- Fatty acids and glycerol , fat soluble vitamins (ADEK)

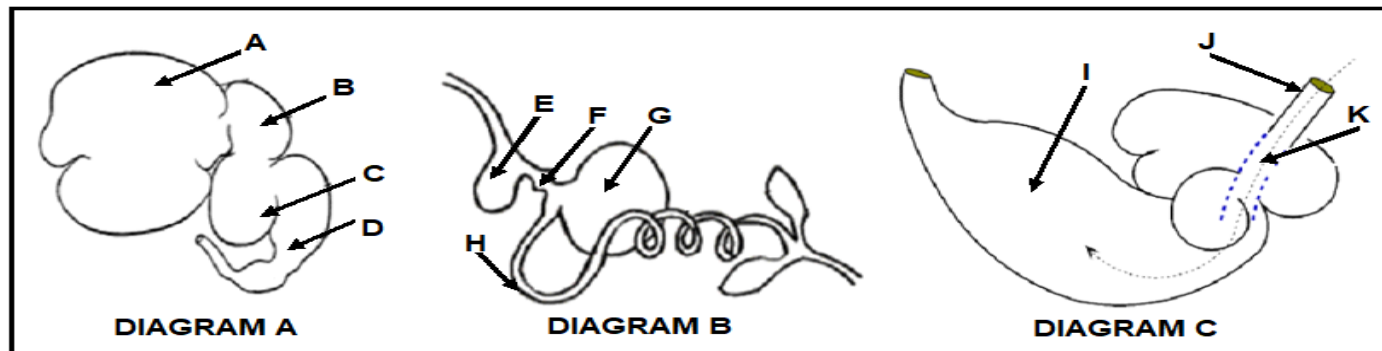
### **4. The fore-stomachs of ruminants absorb:**

- Salts of sodium and potassium
- Volatile fatty acids( Acetic, propionic, butyric acid)
- Water
- Gases like carbon dioxide and

### **5. The absorption in the small intestines:**

- Aided by large absorptive surface area
- Intestinal contractions help by bringing food into contact with epithelial lining which contains numerous villi.

2.1. The diagrams below represent the alimentary canal of farm animals.



2.1.1 Classify the farm animals with the alimentary canals represented by DIAGRAM A and DIAGRAM B above. (2)

2.1.2 Name the farm animals with the alimentary canal represented by DIAGRAM A and DIAGRAM B above (2)

2.1.3 Give a reason for the answer to QUESTION 2.1.2 based on part D and F. (1)

2.1.4 Identify the digestive juice found in parts D, F and I. (1)

2.1.5 Give a reason for the answer to QUESTION 2.1.4. (1)

2.1.6 Identify parts A to K from the diagrams above. (11)

2.1.7 Identify the largest compartment in Diagram A and in Diagram C. (2)

2.1.8 Justify your answer to QUESTION 2.1.7 (2)

2.1.9 Identify the letters (A–K) representing an organ where each of the following function occurs:

(a) Absorption of soluble end products of digestion into the bloodstream (1)

(b) Formation of bolus for regurgitation (2)

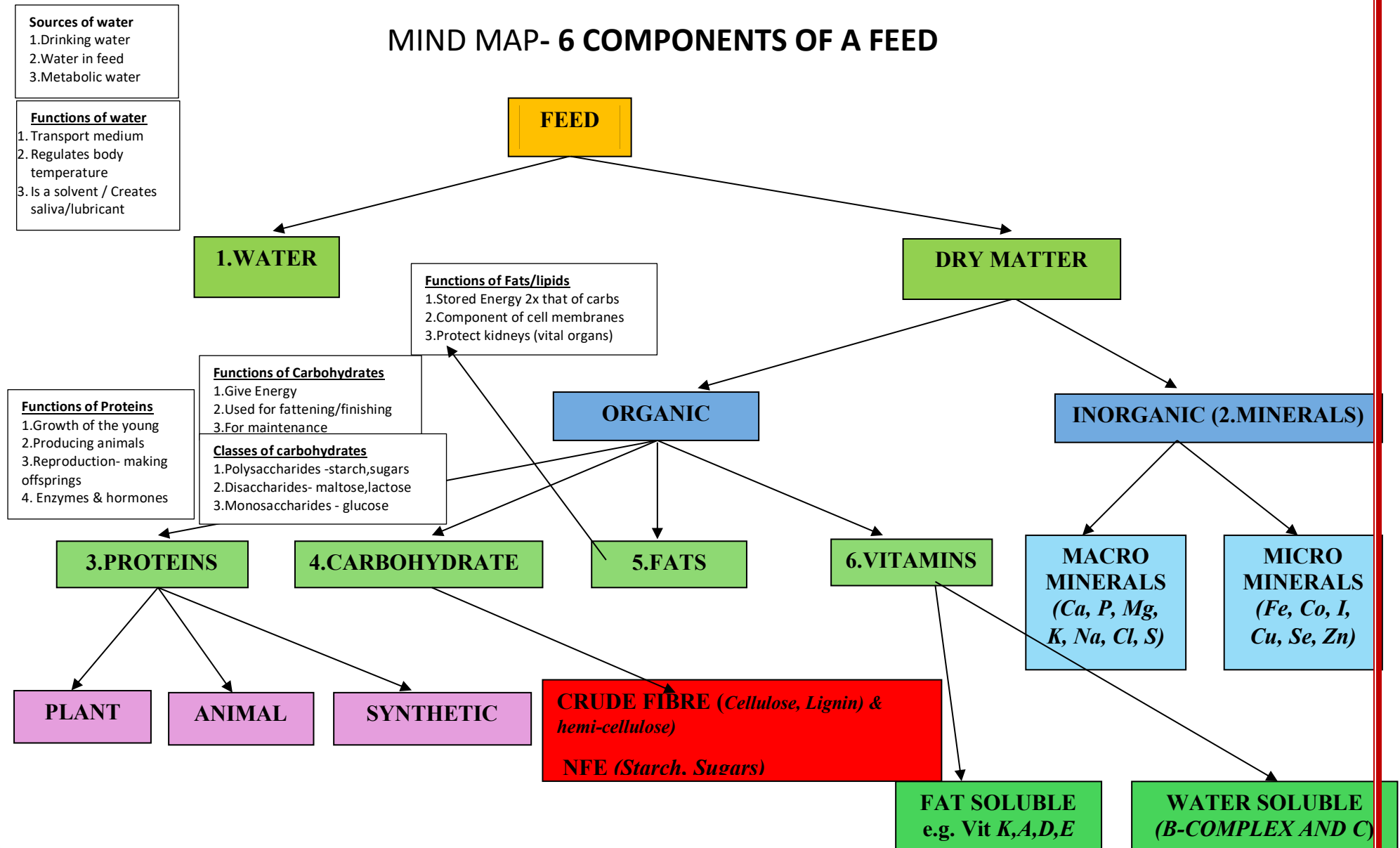
(c) Microbial fermentation of ingested feed in DIAGRAM A (1)

(d) Transportation of milk (1)

(e) Grinding of food in DIAGRAM A. and B (2)

(f) Absorption of the end products of microbe fermentation, such as volatile fatty acids and ammonia through the rumen wall. (1) [31]

## MIND MAP- 6 COMPONENTS OF A FEED



## WATER SOLUBLE VITAMINS

### VITAMINS FUNCTIONS AND DEFICIENCY SYMPTOMS/DISEASES

#### VITAMIN B<sub>1</sub>

**Function:** serves as a coenzyme in carbohydrate metabolism

**Deficiency symptoms:-** [Polyneuritis-damaged nerves] [loss of appetite] [female animals will not come into heat] [lower birth rate and high mortality rate] [decreased lactation in cows] [hens hatch fewer eggs]

#### VITAMIN B<sub>2</sub>

**Function:** serves as a prerequisite for normal growth

**Deficiency symptoms:-** [Curled toe paralysis] [loss of appetite which result in slow growth] [skin rashes and eye abnormalities] [chronic diarrhoea, skin sores, stiff limbs and sore eyes in pigs]

#### VITAMIN B<sub>6</sub>

**Function:** is a constituent of co-enzyme A,  
 • plays a role in biochemical reactions e.g. cholesterol synthesis  
 • is involved in cell respiration

**Deficiency symptoms:-** [skin and hair lesions] [leads to slow growth and reproductive failures] [retardation of growth and feather development in chickens] [pigs exhibit a characteristic goose-stepping]

#### VITAMIN B<sub>12</sub>

**Function:** plays a role in various metabolic reactions, essential for cell

**Deficiency symptoms:-** [Anaemia] [growth is retarded] [hens experience poor hatching] [pigs experience pain in hind quarters, which result in an unsteady walk]

## FAT SOLUBLE VITAMINS

#### VITAMIN A or Beta-carotene

**Function:** [plays a role in the sharpness of normal vision] [controls bone growth] [required for healthy mucous membranes] [required for fertility in both male and female animals]

**Deficiency symptoms:-** [Night blindness] [Keratomalacia] [gives rise to deformed, weak or dead young] [fertility is reduced and can lead to total infertility]

#### VITAMIN D

**Function:**  
 • [helps with the absorption of calcium and phosphorus]  
 • [plays a role in depositing calcium and phosphorus in growing bone]

**Deficiency symptoms:-** [rickets in young animals] [osteomalacia in adult animals] [a decrease in food consumption, which result in slow growth]

#### VITAMIN E

**Function:**  
 • [counteracts the oxidation of unsaturated fatty acids]  
 • [plays a role in normal cell respiration]

**Deficiency symptoms:-** [degeneration of embryos in fowls] [muscle degeneration in sheep] [liver degeneration in pigs]

#### VITAMIN K

**Function:**  
 • Plays a role in blood clotting

**Deficiency symptoms:-** [bleeding, which cannot be stopped]



## MACRO ELEMENTS: FUNCTIONS AND DEFICIENCY, and SOURCES.

### CALCIUM

#### Function:

- Healthy bones and teeth
- Blood clotting
- Maintenance of pH of the body
- Healthy nervous system and muscle tissue

#### Deficiency symptoms:

- rickets in young animals
- osteomalacia in older animals
- milk fever in high producing dairy cows

**Sources:** bonemeal

### PHOSPHORUS

#### Function:

- Healthy bones and teeth
- Metabolism of carbohydrates
- Formation of proteins, nucleic acids & cell membranes

#### Deficiency symptoms:

- rickets in young animals
- osteomalacia in older animals
- milk fever in high producing dairy cows

**Sources:** bonemeal

### MAGNESIUM

#### Function:

- Healthy bones
- Metabolism of carbohydrates
- Activation of enzyme systems

#### Deficiency symptoms:

- Tetanus (muscle contraction)
- Nervousness, hypersensitivity
- Slow growth
- Drop in milk production

**Sources:** bonemeal

### POTASSIUM

#### Function:

- Metabolic function
- Normal digestion
- Regulate acidity

#### Deficiency symptoms:

- Slow growth
- Reduced feed and water intake
- Lower feed efficiency
- Muscular weakness

**Sources:** young plants containing adequate amounts of potassium

### SODIUM AND CHLORINE

#### Function:

- Essential for water metabolism
- Essential for nutrient uptake and transmission of nerve impulses

#### Deficiency symptoms:

- Craving for salt
- Loss of appetite
- Decreased growth
- Reduced milk production

**Sources:** salt mixes containing added iodine and cobalt

### SULPHUR

#### Function:

- Metabolic function
- Amino acid and vitamin formation in rumen

#### Deficiency symptoms:

- Protein deficiency
- Poor performance

**Sources:** forages and grains

## MICRO –ELEMENTS: FUNCTIONS AND DEFICIENCY, AND SOURCES.

IRON	<b>Function:</b> <ul style="list-style-type: none"> <li>• Formation of haemoglobin</li> <li>• Activates various enzymes</li> </ul>	<b>Deficiency symptoms:</b> <ul style="list-style-type: none"> <li>• Anaemia</li> <li>• Paleness of mucous membranes</li> <li>• Listlessness, fatigue, diarrhoea</li> </ul>	Sources: green forage
COBALT	<b>Function:</b> <ul style="list-style-type: none"> <li>• Building block of vitamin B<sub>12</sub></li> <li>• Normal digestion, growth and milk production</li> <li>• Synthesis of haemoglobin</li> </ul>	<b>Deficiency symptoms:</b> <ul style="list-style-type: none"> <li>• Wasting disease</li> <li>• Listlessness, loss of appetite</li> <li>• Low fertility, drop in milk production</li> </ul>	Sources: green forage
IODINE	<b>Function:</b> <ul style="list-style-type: none"> <li>• Constituent of the hormone thyroxine</li> </ul>	<b>Deficiency symptoms:</b> <ul style="list-style-type: none"> <li>• Goitre</li> <li>• Low production capacity</li> <li>• Gives birth to hairless weak or dead young</li> </ul>	Sources: marine salts
ZINC	<b>Function:</b> <ul style="list-style-type: none"> <li>• Healing of damaged tissues</li> <li>• Hair and feather development</li> <li>• Enzyme activity</li> </ul>	<b>Deficiency symptoms:</b> <ul style="list-style-type: none"> <li>• Parakeratosis</li> <li>• Keratinisation of wool</li> </ul>	Sources: legumes
SELENIUM	<b>Function:</b> <ul style="list-style-type: none"> <li>• Antioxidant, glutathione peroxidase assist in vitamin E absorption and utilisation</li> </ul>	<b>Deficiency symptoms:</b> <ul style="list-style-type: none"> <li>• Muscular dystrophy/White muscle disease</li> <li>• Heart failure</li> <li>• Low fertility</li> <li>• Liver necrosis</li> <li>• Pancreatic fibrosis in chicks</li> </ul>	Sources: forages and grains
COPPER	<b>Function:</b> <ul style="list-style-type: none"> <li>• Formulation of haemoglobin</li> <li>• Synthesis of hair and pigments</li> <li>• Normal bone formation</li> <li>• Tissue metabolism</li> </ul>	<b>Deficiency symptoms:</b> <ul style="list-style-type: none"> <li>• Swayback (lambs)</li> <li>• anaemia</li> </ul>	Sources: forages and grains

### SUPPLEMENTING MINERALS

Methods/ways in which minerals are given to animals:

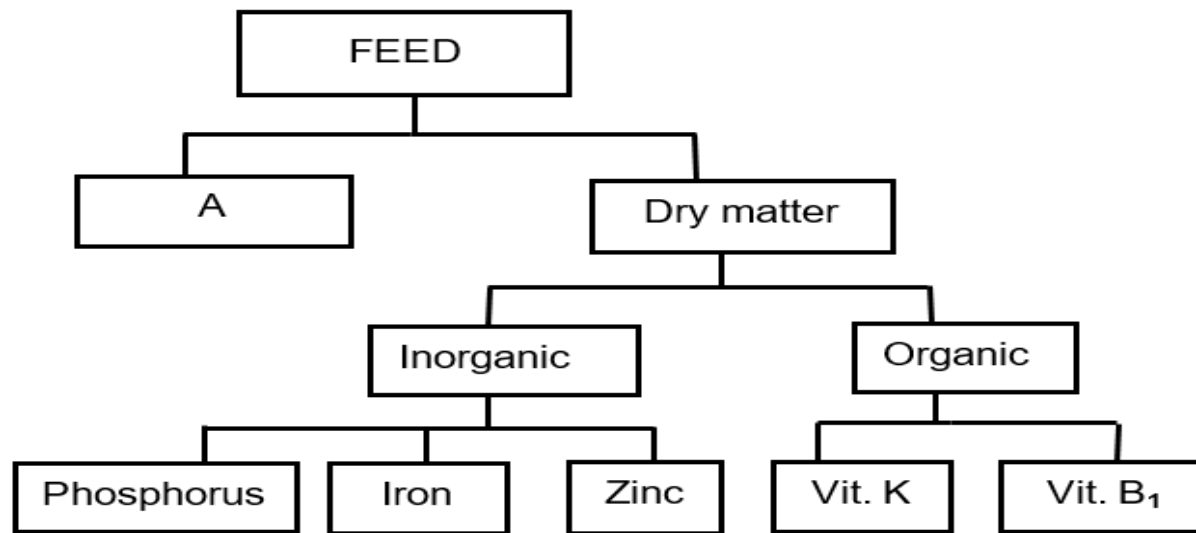
1. Mineral licks
2. Drinking troughs
3. Supplanting rations
4. Dosing
5. Injections
6. Cafeteria style or free choice in minerals
- Ad lib if free choice in feed)
7. Soil sods ( iron)

### SUPPLEMENTING VITAMINS

Methods/ways in which vitamins are given to animals:

- 1) Injection
- 2) Mix with water

3.1 The flow chart below shows components of feed needed by farm animals for effective functioning.



- 3.1.1 States TWO sources of component A in the animal body. (2)
- 3.1.2 State TWO roles of component A in digestion of farm animals (2)
- 3.1.3 Identify a term in the chart above that represents the actual nutrient content of the feed, excluding water. (1)
- 3.1.4 Identify the component in the flow chart above that will result in the following deficiency symptoms: (1)
- (a) Slow healing of wounds in farm animals (1)
  - (b) Excessive bleeding in chickens (1)
  - (c) Chewing of dry bones by farm animals (1)
  - (d) Staggering, incoordination, star-gazing posture, polyneuritis (inflammation of nerves in fowls) (1)
  - (e) Pale mucous membrane, anaemia caused by low haemoglobin levels in blood. (1)
  - (f) Parakeratosis (1)

- 3.1.5 Indicate the organic component in the flow chart above that is
- (a) Fat soluble (1)
  - (b) Water soluble (1)
  - (c) Macro-mineral (1)
  - (d) Micro-element (1)
- 3.1.6 Suggest THREE methods of supplementing the inorganic components of the feed. (3)
- 3.1.7 Suggest TWO methods of supplementing the organic components of feeds in the chart above. (2)
- 3.1.8 Name THREE other vitamins **synthesized by rumen microbes** that are not listed in the chart above (3)
- 3.1.9 Name THREE other fat soluble vitamins that are NOT synthesized by rumen microbes. (3)
- [26]**

## DIGESTIBILITY COEFFICIENT/CALCULATION AND BIOLOGICAL VALUE

### Coefficient of digestibility:

- Digestibility – Portion of DM feed absorbed
  - Digestibility coefficient – Percent of DM feed absorbed.
- Measure of the digestibility of a feed expressed as a percentage in terms of dry material.

### Factors that affect/influence the Digestibility of a feed :

- |                          |                             |
|--------------------------|-----------------------------|
| 1. Feed composition      | • Quantity of feed taken in |
| 2. Composition of ration | • Age of plant              |
| 3. Preparation of feed   | • individuality             |
| 4. Type of animal        |                             |

### Factors that determine Digestibility of hay:

1. Crop from which hay was produced
2. Stage at which hay was cut for making hay
3. Method of making hay
4. Preparation of hay
5. Supplementation with NPN
6. Supplementation with molasses

### Calculating the coefficient of digestibility:

- **Step 1:** change the feed and manure values to dry values by calculation
- **Step 2:** use the formula and substitute the changed(Dry values):
- Step 3: Simplify and write the **answer as percent /%**

$$\text{Coefficient of Digestibility} = \frac{\text{DM (intake) kg} - \text{DM (Manure)kg} \times 100}{\text{DM (intake) kg}} \quad 1$$

- **Step 3 (if requested):** interpret the value obtained
  - ✓ A higher DC or percentage of digestibility means that more nutrients can be absorbed from the feed.
  - ✓ A lower DC or percentage of digestibility means that less nutrients can be absorbed from the feed.

### Why is the DC of a feed so important?

### Methods or strategies/ways to Improve the digestibility of feeds:

- Grinding
- Rolling
- Popping and micronising
- Roasting
- Pelleting
- Soaking

## THE BIOLOGICAL VALUE OF PROTEINS

### The concept: Biological Value (BV)

- Refers to the index of the quality of a protein.
  - ✓ A feed with a high BV provides all amino acids needed by an animal
  - ✓ A feed with a low BV does not provide all amino acids required by an animal

### Why is the BV important?

- ✓ It allows us to compare the ability of various animal feeds to effectively supply all of the animals needs
  - ✓
  - BV is an index of the quality of protein in the feed
- 2.9.2 Relation between the BV and the quality of a feed
- The higher the BV, ✓ The better the quality of a feed ✓
  - The lower the BV , ✓The lower the quality of a feed ✓

### The Concept: Essential Amino Acid Index:

- ✓ Refers to the ratio of the amount of 10 essential amino acids contained in a feed relative to the amount of amino acids in egg protein.
- ✓ The ratio is calculated relative to egg protein because eggs have **ideal** amino acid content
- ✓ **ideal proteins are those that supply all the essential amino acids in the right amounts and an example of an ideal protein is found in eggs**
- ✓ The BV of egg protein is considered to be 100, and **this is because it**

### Importance of animal proteins in rations:

- ✓ Required for growth
- ✓ Required for production
- ✓ Required for reproduction

4.1 The following information was used during a digestibility trial conducted on a group of ruminant farm animals:  
Dry material content of the feed = 88% (moisture 12%), Dry material content of the manure = 77% (moisture 23%)  
Manure excreted was 5 kg after the average feed intake of 15 kg

4.1.1 Calculate the digestibility co-efficient of this feed. (5)

4.1.2 Explain the implication of the value calculated in QUESTION 2.2.1. (1)

4.1.3 Deduce the percentage of feed that was not absorbed. (1)

4.2. The table below shows the digestibility coefficient of two feeds (**A** and **B**).

	Coefficient of digestibility
<b>FEED A</b>	85% of 25 kg DM
<b>FEED B</b>	55% of 17 kg DM

4.2.1 Deduce the feed (A or B) that is :

(a) a roughage (1)

(a) a concentrate (1)

4.2.2 Give TWO reasons for your answer in Question 4.2.1 (a). (1)

4.2.3 Calculate the percent of Feed A excreted. (2)

4.2.4 Calculate the amount (kg) of Feed A excreted. (2)

4.2.5. Indicate THREE factors that influence the digestibility of feed A.

4.2.6 Mention THREE factors that determine the digestibility of feed B.

4.2.7 Name TWO methods/ways/processes to increase the digestibility of feed B.

### 4.3 BIOLOGICAL VALUE OF FEEDS

Below are examples of different feeds with their biological values

Feed/Protein Source	Biological Value (%)	Quality of protein
Egg protein	100	Highest BV
Milk protein (casein)	90	Excellent quality
Fish meal	80	high-quality and rich in most essential amino acids except methionine
Soybean meal	75	Rich in lysine but low in methionine
Meat and bone meal	65	low in lysine and tryptophan
Cereal grains (e.g., corn)	55	low in lysine and tryptophan
Groundnut cake	45	Low in lysine

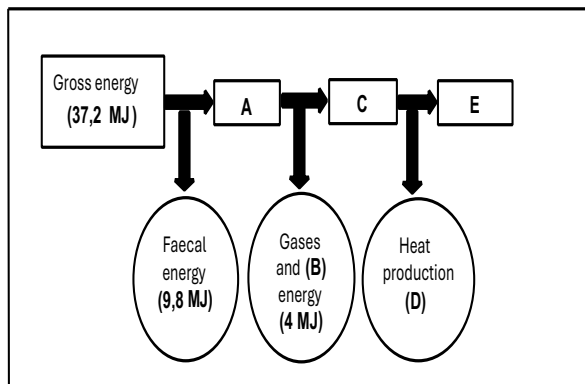
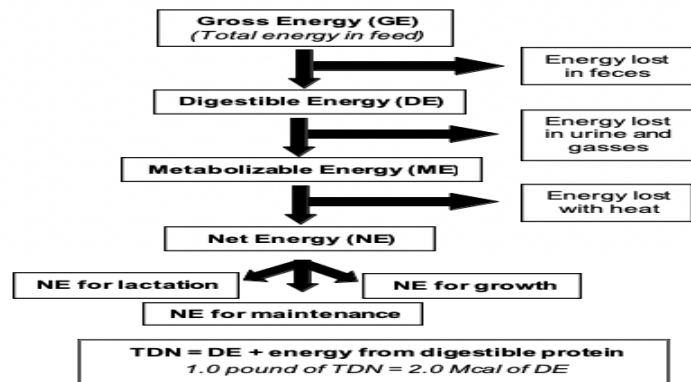
4.3.1 Define Biological value. (2)

4.3.2 Identify the plant based feed with the highest BV in the table above. (1)

4.3.3 Compare the feeds egg protein and groundnut cake in terms of their BVs in the table above. (2)

4.3.4 Draw a bar graph to compare the biological values of feeds in the table above.

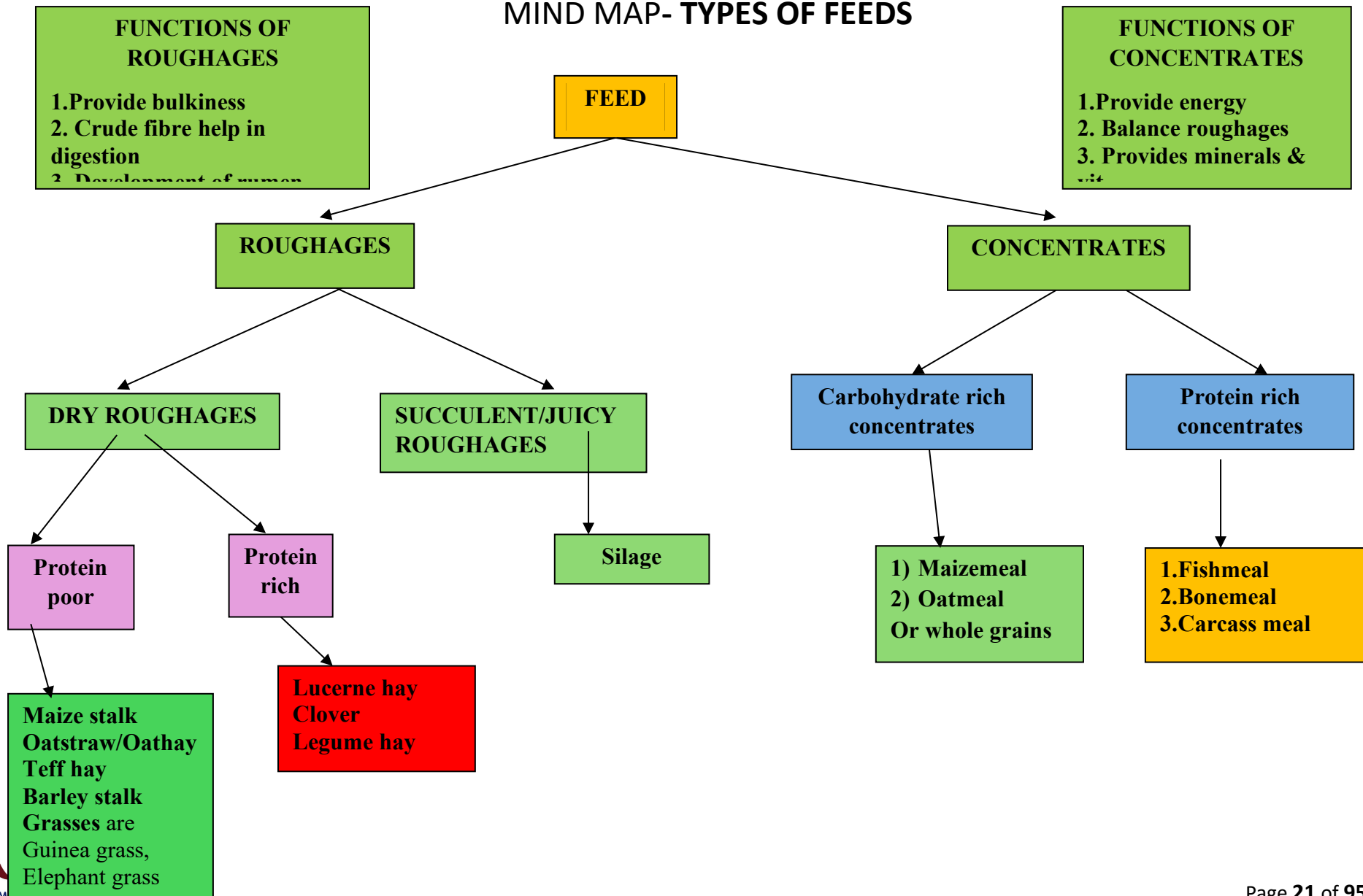
4.3.5 Indicate the relationship between the BV and the quality of a feed.



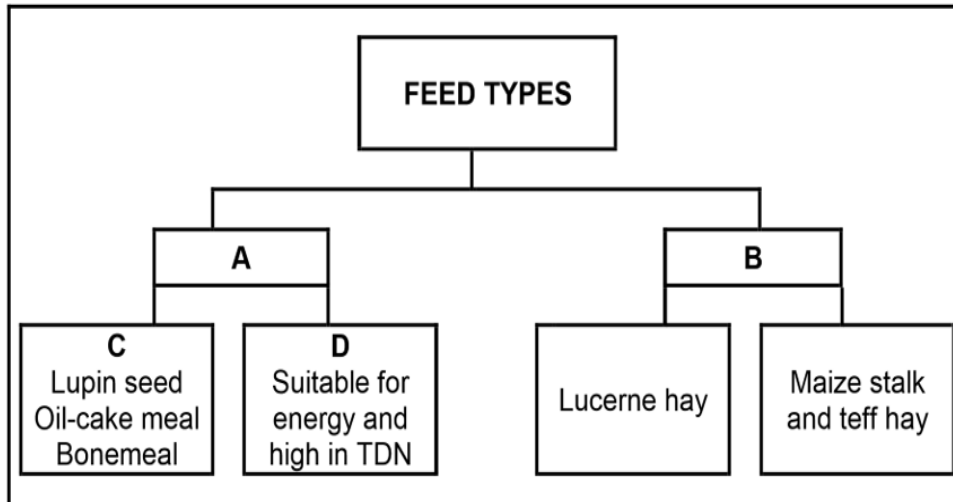
- 4.4.1 Label the energy represented by **A**, **B**, **C** and **E** (4)
- 4.4.2. Indicate the function of energy **E**. (2)
- 4.4.3. Calculate the values of the energy represented by **A**, **C**, **E**. Show ALL calculations. (6)



## MIND MAP- TYPES OF FEEDS



5.1 Below is a schematic representation of feed types used in the feeding of farm animals.



5.1.1 Classify feed types A and B. (2)

5.1.2 Identify the subdivision of feed type C. (1)

5.1.3 Give TWO examples of the subdivision of feed type D. (2)

5.1.4 Feed type B is mainly fed to ruminant animals. Give TWO reasons to justify this statement. (2)

TOTAL MARKS: (7)

## NUTRITIVE RATIO

### Nutritive value of a feed:

is the amount of a specific nutrient in a feed  
example:

Nutrient	Value
Calcium	20 g/kg

Crude protein      30 g/kg

### Nutritive Ratio (NR):

**Defn** -It is the ratio between the digestible protein and the digestible non nitrogen components (carbohydrates and fats) in a feed.

-is a figure used to express the relationship of digestible protein to the total energy in the feed or ration  
-is used as a measure of the value of a ration for growth compared with a fattening ratio.

- ✓ Is an indicator of the protein content of a feed

### Calculating the nutritive ration of a feed:

NR= 1:  $\frac{\% \text{ Digestible non—nitrogen substances}}{\% \text{ Digestible Protein}}$  or  $\frac{\% \text{ DNNC}}{\% \text{ DP}}$  or  $\frac{\% \text{ Total Digestible Nutrients} - \% \text{ Digestible Protein}}{\% \text{ Digestible Protein}}$

- ✓ **NARROW nutritive ratio (i.e. NR < 1:6) , rich in proteins and good for Growth, Production and Reproduction (GPR)**
- ✓ **WIDE nutritive ratio (i.e. NR > 1:6, rich in carbohydrates and suitable for Fattening or finishing, Energy and Maintenance (FEM))**
- ✓

**If NR is 1:4      (what does it mean?)**

**For every 1 part of DP, there are 4 parts of DNNC**

### Interpretation of nutritive ratio of a feed:

- ✓ A ration with a narrow nutritive ratio (NR < 1:6) is suitable for **growth, production and reproduction purposes [ GPR]**
- ✓ A ration with a wide nutritive ratio (NR > 1:6) is suitable for **fattening, energy and maintenance purposes. [ FEM]**

For maintenance	For fattening	For growth	For milk production	For reproduction
NR not wider than 1:8	NR not wide 1:10	NR must be 1:5 or less	NR must be 1:5 or less	NR must be 1:5 or less
Requires DP to replace worn out tissues.	Requires DP for maintenance	Requires lots of proteins of high BV for muscle growth	Requires lots of proteins of high BV	Requires lots of proteins of high BV
Requires carbohydrates, fats and vitamins for maintenance	Requires carbohydrates and fats in large quantities	Requires carbohydrates and fats for maintenance	Sufficient carbohydrates and fats for maintenance and production	Requires carbohydrates and fats for maintenance and increased support in the last third of pregnancy

COMPONENT	FEED A	FEED B
Digestible protein (DP)	8%	12%
Carbohydrates	50%	40%
Fats	22%	5%
TDN	-	67%
NR	-	1:5

- 6.1.1 Define Nutritive ratio. (2)
- 6.1.2 Work out the DNNC (Digestible Non-Nitrogen Components) of feed A. (2)
- 6.1.2 Calculate the nutritive ratio (NR) of feed A. (4)
- 6.1.3 Identify the feed (A or B) that is most suitable for fattening animals. Justify your answer. (3)
- 6.1.4 Indicate the feed (A or B) that is most suitable for young, growing animals. Motivate your answer. (3)

6.2 The following are the nutritive ratios of different feeds:

Feed A – 1 : 4

Feed B – 1 : 10

Feed C – 1 : 8

6.2.1 Recommend the feed (A, B or C) that a farmer can use in EACH of the following situations:

- (a) Animals that are fattened (1)
- (b) Lactating animals (1)
- (c) Animals that are maintained (1)

6.2.2 Indicate the part of the ratio in Feed C that represents non-nitrogen digestible nutrients. (1)

6.2.3 Feed A is recommended for feeding a one-month-old calf. Justify this statement. (1)

## PLANNING A FEED FLOW PROGRAMME – The Pearson's Square

### Types of ration:

**Maintenance ration:** the amount of feed that an animal needs to maintain the body mass and composition

**Production ration:** the feed an animal needs in addition to the maintenance ration, to do work or produce products.

### Why do we need a feed flow programme?

To ensure that animals receive correct nutrients in the right proportions in their rations

### The Pearson's Square Method

- ✓ With this method, aim is to minimise the cost of a ration

### The approach:

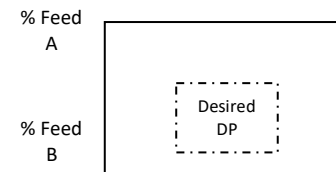
- ✓ Feeds with varying nutritional values have to be combined and balanced to meet the maintenance and production needs of an animal

We need to know the percentage values of the nutrients that are to be balanced in order to calculate. Nowadays computer programmes are used to balance rations. **NB: the Pearson square can be used for DP values or TDN values**

### The method:

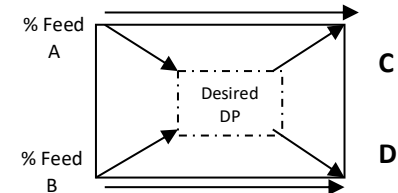
**Step 1:** Draw a square and place

- ✓ The DP value for feed A at the top left-hand corner of the square
- ✓ The DP value for feed B at the bottom left-hand corner of the square
- ✓ The desired DP value of the new mixture in the middle of the square



**Step 2:**

- ✓ Subtract the value of the desired DP from the value of feed A and place the answer obtained at the bottom right hand corner of the square [NB – this % value will represent the number of parts of feed B] represented by C
- ✓ Subtract the value of the desired DP from the value of feed B and place the answer obtained at the top right hand corner of the square [NB – this value will represent the number of parts of feed A] represented by D



**Step 3:**

- ✓ Add values C and D to obtain the TOTAL of the two. This value will be used to calculate the % or quantities of either of the feeds required.  $C + D = E$
- ✓ Divide the value of feed C by the total E and multiply by 100 to obtain the percentage of feed C in the feed mixture. Do the same for feed D.

Formula for calculating % /kg of feed A:  $\frac{C}{E} \times \frac{100}{1}$  or ..kg = Percentage of feed A in the mixture

Formula for calculating %/kg of feed B:  $\frac{D}{E} \times \frac{100}{1}$  or ..kg = Percentage of feed B in the mixture

### Fodder flow planning

Strategic planning to ensure that all animals have enough feed throughout the year. IF

Feed available – feed required = 0. means good

Feed available – Feed required = positive + **answer** means **surplus** ( which must be cut and stored for difficult times.

Feed available – Feed required = negative - **answer** means **shortage** and therefore it means:

1. Reduce by culling or selling
2. Use stored hay

**Feed requirement** = daily requirement in kg X number of animals X duration (in days).

If months not mentioned use average of 30 days

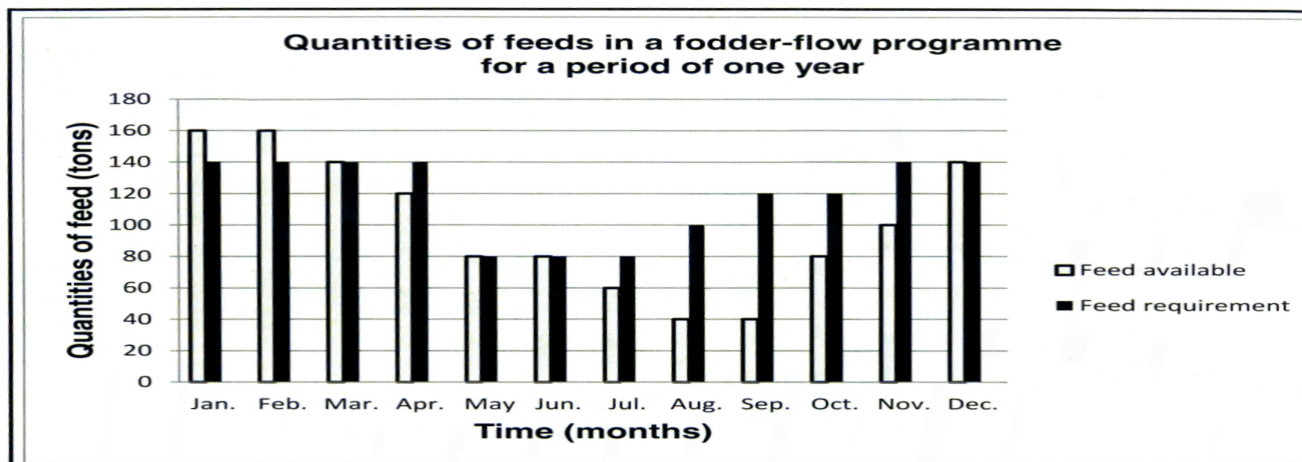
If months is mentioned e.g. Jan use 31 days

Annual (365/12 = 30.4 days), 3 months (365/3 = 121.6 days etc)

### Properties of a good fodder flow plan

1. Safe use of resources
2. Meeting animal requirements
3. Margin over feed costs
4. Manageability

8.1 Study the graph below and answer the questions that follow.



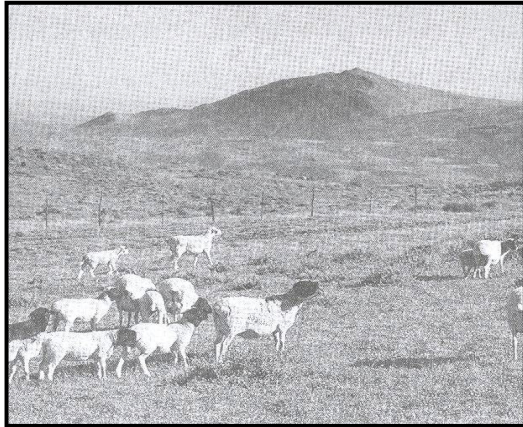
- 8.1.1 Deduce, from the bar graph above, the number of months during which there will be more feed available than required by animals. (1)
- 8.1.2 Indicate a particular month during which the required feed will be most insufficient for the animals. (1)
- 8.1.3 Calculate the surplus/shortage of feed during February and October in kilograms (kg) respectively. (3)
- 8.1.4 Suggest THREE cost-effective measures for better utilization of feed that could be applied in January and February. (3)

### Activity 1

## QUESTION 1

1.1 The following pictures illustrate two production systems. PICTURE A shows a sheep farming enterprise in the Karoo and PICTURE B shows a farmer working in a layer unit.

**A**

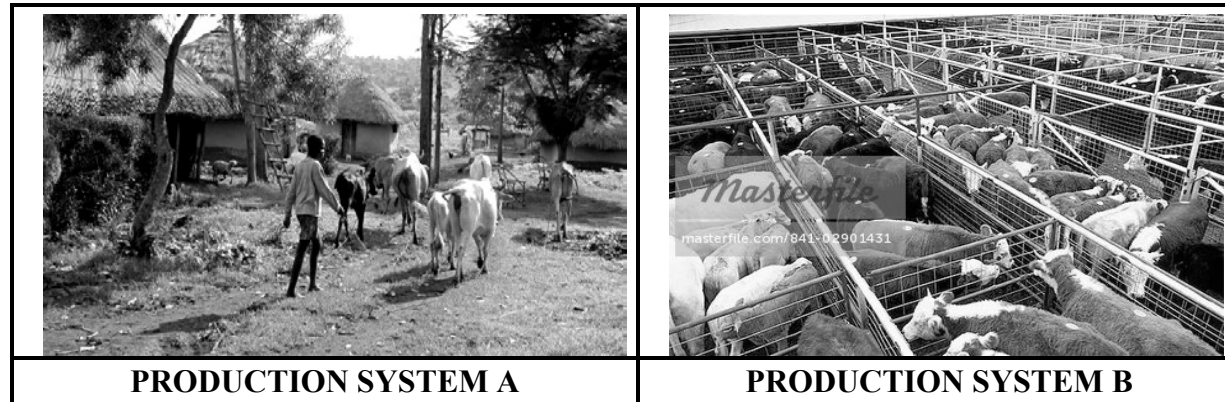


**B**



- 1.1.1 Identify whether PICTURES A and B above represent intensive or extensive production systems. (2)
- 1.1.2 Tabulate TWO differences between the production systems mentioned in QUESTION 1.1.1. (4)
- 1.1.3 Name a farming enterprise, related to the pictures above, which has the highest risk factor with regard to climate. (2)  
Justify your answer.

1.2 The pictures below show animal production systems.



- 1.2.1 Identify production system **A** and production system **B** above. (2)
- 1.2.2 Compare production system **A** and production system **B** with reference to capital investment. (2)

1.3 The table below shows the feeding programme used to increase broiler production.

GROWTH STAGE	NUTRITIONAL REQUIREMENTS
A. Day-old chick	High in protein
B. 3- to 4-week-old chickens	Diet with a high percentage of energy

- 1.3.1 Compare the nutritional requirements of broilers in growth stage **A** and growth stage **B**. (2)
- 1.3.2 Give a reason for the nutritional requirement in growth stage **A**. (1)
- 1.3.3 Name TWO other factors to increase production in broilers, except nutritional requirements. (2)

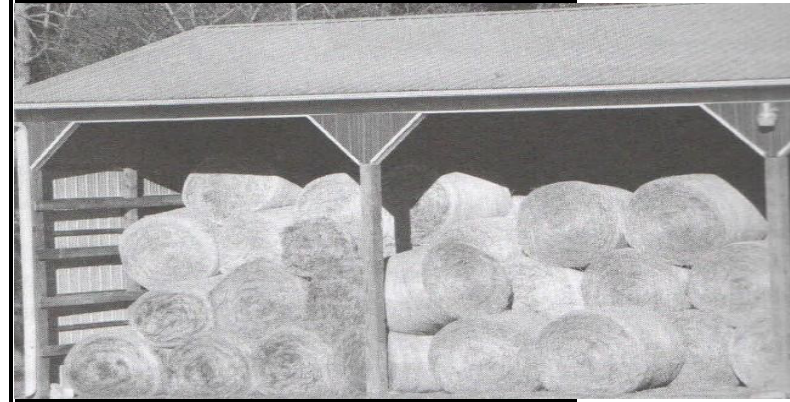


Question 2 The pictures below show the different facilities used in production systems.

**PICTURE A**



**PICTURE B**



**PICTURE C**



**PICTURE D**



- 2.1.1 Identify the production system in picture C. (1)
- 2.1.2 Give a reason for the answer to QUESTION 2.1.1. (2)
- 2.1.3 Write down the letter of the picture that represents EACH of the following:
- (a) Feed shed (1)
  - (b) Holding pen (1)
- 2.1.4. Differentiate between the facilities in picture A and picture D in terms of their purpose. (2)
- 2.1.5 Identify the role of equipment E in picture D. (1)
- 2.1.6 Name TWO basic guidelines for handling large farm animals. (2)

### QUESTION 3

- 3.1 The production system below is commonly used in rural communities on a small scale. Chickens are fed using left over food from the house and grain crops from fields.



- 3.1.1 Identify the type of poultry production system above that is normally used by rural communities. (1)
- 3.1.2 Name THREE advantages of the system in QUESTION 3.1.1. (3)
- 3.1.3 State THREE problems that could be associated with this type of production system. (3)

## QUESTION 4

- 4.1 You investigated the production outputs of two feedlots (Sondela Feedlot and Nkomani Feedlot). The production output was calculated by combining the daily weight gain, days at the feedlot, carcass value and grading of the carcass. The average feeding cost per animal was calculated as units of an index value, and the cost of their breeding and genetic improvement programmes were also calculated as such index values. The table below represents production outputs and cost distribution (feeding and genetics) per animal calculated as index values for these two farmers.

Farm	Output/animal (index value)	Feeding cost/animal (index value for total cost)	Breeding and genetic improvement cost/animal (index value for total cost)
Sondela Feedlot	72	60	18
Nkomani Feedlot	68	75	6

- 4.1.1 Indicate the feedlot which operated at the highest cost. (1)
- 4.1.2 Determine the feedlot which operated in the most cost-efficient way. Explain your answer by referring to the given data. (3)
- 4.1.3 Deduce from the data the most cost-efficient way to improve the output of a feedlot. (1)
- 4.1.4 Name ONE environmental factor that may have an influence on the production. (1)
- 4.1.5 Recommend ONE possible method that could be implemented to improve the genetic potential of animals in a feedlot. (1)

## QUESTION 5

5.1 The farmers below are involved in two different production systems.

FARMER A	FARMER B
Farming in a 4 800 ha semi-arid area with 2 workers. The farm has 1 farm shed, 8 wind pumps, 1 cattle-handling facility, 1 dipping station and 400 cattle kept on natural pasture.	Farming in a 400 ha wet area with 20 workers. The farm has 6 farm sheds, 25 feedlot camps, 3 cattle-handling facilities, 3 dipping stations and 3 500 cattle.

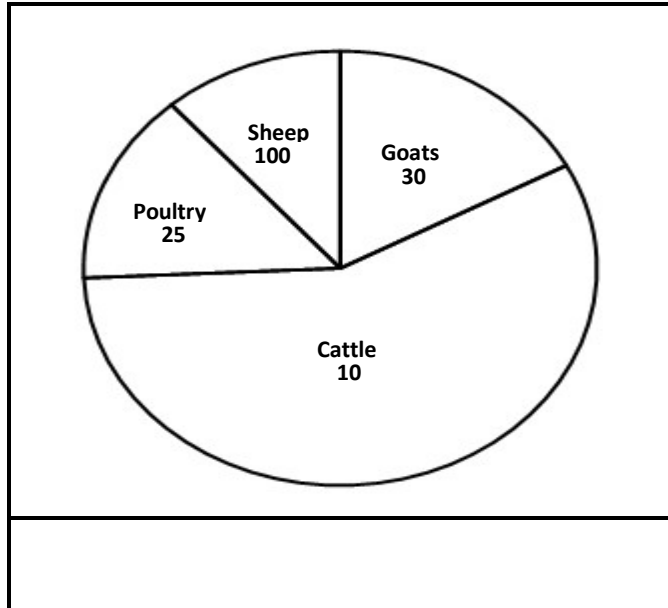
- 5.1.1 The implementation of a rotational grazing system (1)
- 5.1.2 Give TWO reasons from the table that support the answer to QUESTION 5.1. (2)
- 5.1.3 Briefly distinguish between the feeding strategies followed by FARMER A and FARMER B. (2)
- 5.1.4 State TWO measures that FARMER A can take to increase . production. (2)

## QUESTION 6

- 6.1 In South Africa the climate to produce farm animals varies from region to region and different regions utilize different animal breeds and Systems of production. Some animals require shelter and other forms of environmental control for optimal production. Other production systems utilize vast grazing areas for animal production and rely on relevant environmental conditions Knowledge of animal characteristics and the expected behavior of livestock farmers during the handling of farm animals play a significant role in determining the methods and types of production that will be used in the production process.
- 6.1.1 Name TWO main production systems commonly practiced by animal producers in South Africa. (2)
- 6.1.2 Name THREE factors that farmers should consider when deciding on the site for the construction of shelter to maximize production. (3)
- 6.1.3 State TWO factors that determine the behaviour of an animal. (2)
- 6.1.4 Name TWO characteristics or warning signs that can be displayed by animals to indicate fear, aggression and contentment, which the handler should bear in mind when working with animals. (2)

## QUESTION 7

7.1 The pie chart below shows the number and type of farm animals, including the size of the area where they are kept.



7.1.1 Refer to the pie chart above and identify the farm animals that are kept under intensive production conditions. (1)

7.1.2 Give a reason for the answer to QUESTION 7.1.1(1)

7.1.3 Refer to the pie chart above and identify the farm animals that use EACH of the following facilities:

(a) Laying batteries (1)

(b) Milking parlour (1)

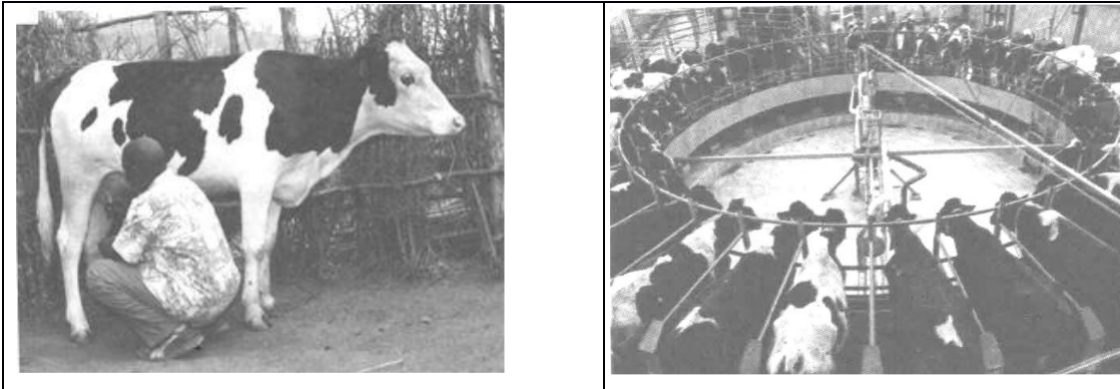
(c) Shearing shed (1)

7.1.4 Calculate the percentage (%) of sheep from the total number of farm animals on this farm. (3)



## Question 8


8.1 The pictures below show farming systems.



**FARMING SYSTEM A**

**FARMING SYSTEM B**

- 8.1.1 Identify farming system **A** and farming system **B** in the photographs above. (2)
- 8.1.2 Compare the TWO farming systems regarding the following:
- (a) Purpose of the output (2)
  - (b) Impact on the environment (2)
- 8.1.3 State ONE disadvantage of farming system **B** when the hygienic measures are not observed. (1)
- 8.1.4 State ONE economic benefit of farming system **B** over farming system **A** for the farmer. (1)
- 8.1.5 Mention THREE challenges associated with commercial beef farming in South Africa. (3)

Describe the common behaviour of cattle, sheep, pigs and poultry under various conditions		
	Give the reasons/importance of handling farm animals	
8.	Describe the effect of incorrect handling of farm animals (harm&effect	
9.	State the basic guidelines for handling cattle,sheep, pigs,and poultry	
10	Identify and describe the different techniques/tools/aids/facilities (design features e.g. loading ramps,crush,vehicle used to handle animals	

## Question 9

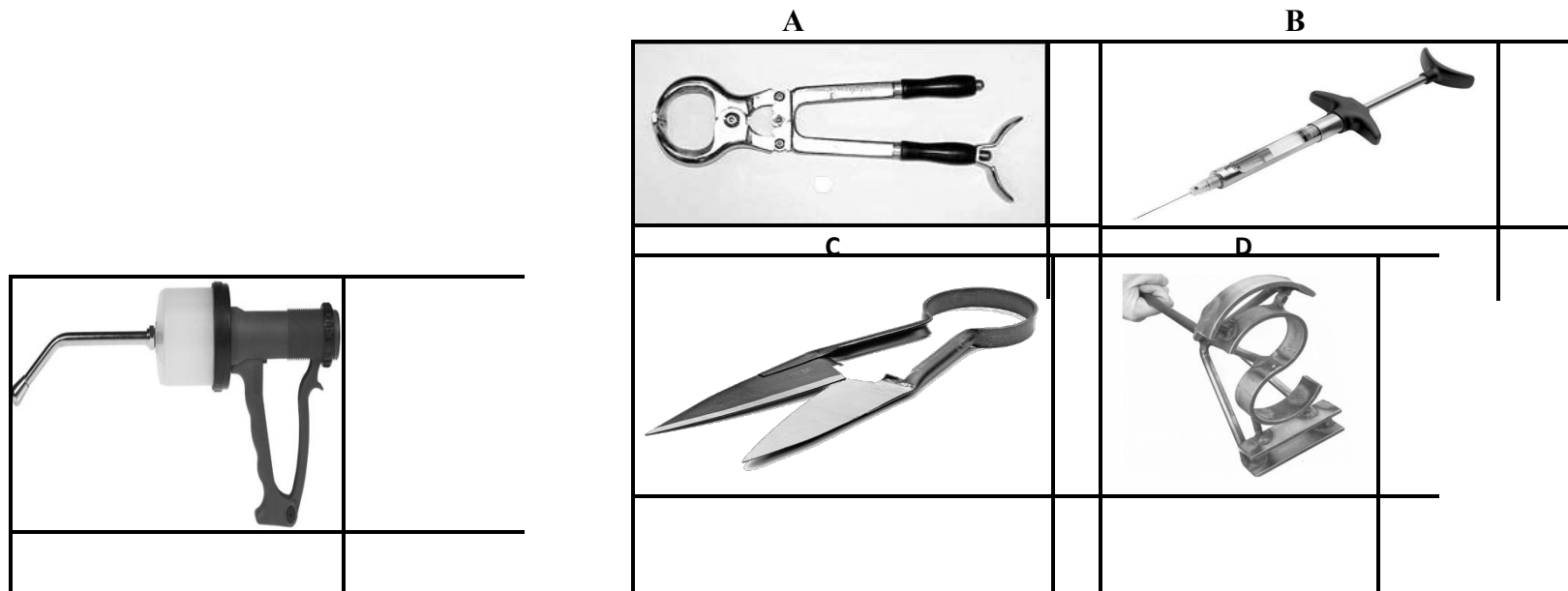
9.1 The photographs below show animal handling facilities in an intensive production system.



- 9.1.1 Identify handling facility **A** and handling facility **C**. (2)
- 9.1.2 Give the main purpose of structure **B** that is attached to handling facility **C**. (1)
- 9.1.3 Name TWO design features of handling facility **C** for the proper handling of farm animals. (2) .



9.2 The pieces of equipment below are utilised for different handling techniques of farm animals.



9.2.1 Match equipment (A–E) above with the handling techniques ((a)–(e)) below, e.g. (a) F:

- |   |     |
|---|-----|
| (a) Crutching the wool in the wet areas around the tail | (1) |
| (b) Branding of cattle.                                 | (1) |
| (c) Castration of older calves                          | (1) |
| (d) Oral administration of worm remedies                | (1) |
| (e) Intravenous administration of medicines             | (1) |

9.2.2 Give TWO reasons for handling cattle, other than the ones indicated in QUESTION 9.2.1.

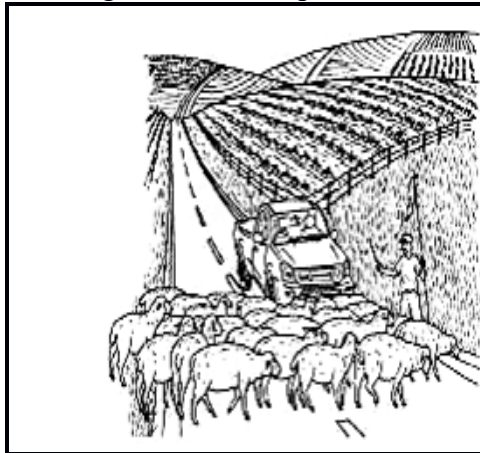
9.3 Indicate the farm animals that show the following types of behaviour during handling:

- |       |                                       |     |
|-------|---------------------------------------|-----|
| 9.3.1 | Pawing when in distress               | (1) |
| 9.3.2 | Easy to handle when they are together | (1) |
| 9.3.3 | Panting when they are stressed        | (1) |
| 9.3.4 | Peck when feeding                     | (1) |

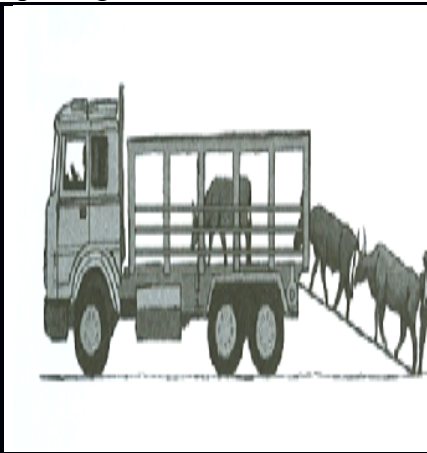
#### QUESTION 10

- 10.1 Losses arising from injury, bruising and death amongst cattle in transit between the farm and the abattoir are substantial. This must be avoided for legal, anti-animal cruelty and financial reasons. It is therefore imperative that cattle be handled sympathetically as much as possible to minimise these losses.

The diagrams below represent modes of transporting animals, marked **A** and **B**.



**DIAGRAM A**



**DIAGRAM B**

10.1.1

- 10.1.2 Name TWO tools that must be used when animals are moved along the road, as illustrated in DIAGRAM A.

10.2 Name the structure, apparatus or appliance used in EACH of the following situations to manage farm animals:

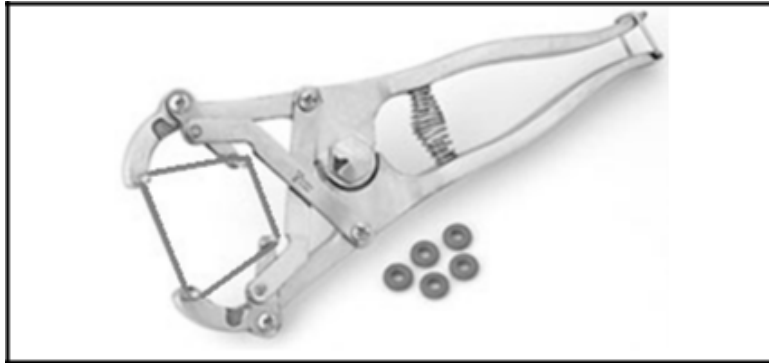
10.3.1 A permanent structure next to a provincial road to restrain farm Animals. (1)

10.3.2 An appliance used to restrict the movement of a farm animal. (1)

10.3.3 Apparatus used to castrate young rams (1)

10.3.4 The structure used to protect sheep and cattle against adverse weather conditions. (1)

10.4 The photograph below shows an apparatus used to perform certain livestock management practices.



10.4.1 Identify the apparatus above. (1)

10.4.2 Name TWO management practices for this apparatus in sheep. (2)

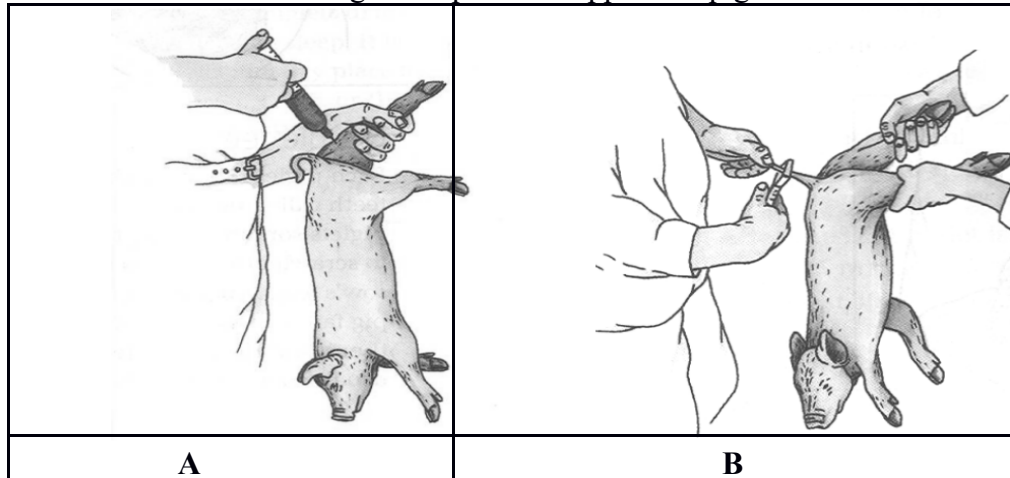
10.4.3 Give ONE reason why EACH management practice in QUESTION 10.4.2 is important. (2)

## 11.1

The loading and transportation of farm animals may cause enormous stress and physical injuries. Proper facilities should be used when loading animals. A permit must be carried when transporting farm animals.

- |        |  |     |
|--------|--|-----|
| 11.1.1 | Name the facility used to direct farm animals towards the loading ramp.                              | (1) |
| 11.1.2 | Give TWO measures to consider when designing the facility in QUESTION 11.1.1.                        | (2) |
| 11.1.3 | Identify the relevant document to be carried by the driver when transporting farm animals.           | (1) |
| 11.1.4 | State TWO precautionary measures a farmer must take to reduce stress when transporting farm animals. | (2) |

11.2 The pictures below indicate management practices applied to piglets.



- |        |  |     |
|--------|--|-----|
| 11.2.1 | Identify management practices <b>A</b> and <b>B</b> in the pictures above. | (2) |
| 11.2.2 | Give a reason for management practice <b>A</b> and <b>B</b> .              | (2) |

11.2.3 Refer to <b>A</b> and name the mineral that is usually given to piglets.	(1)
---	-----

11.2.4 Give TWO reasons to motivate the answer to QUESTION 3.2.3.	(2)
---	-----

## Question12

### Naming of tool

ear tag; branding iron; smart neck band; tattoo pliers
--

Used to leave a particular permanent mark on the animal, especially cattle	(1)
--	-----

Used to identify animals with specific coded information on family lines and generation	(1)
---	-----

Equipped with an advanced electronic device to locate an animal and send feedback on the actions performed by the animal	(1)
--	-----

Used for the identification of animals, especially stud horses	(1)
--	-----

### QUESTION 13

13.1 The table below shows information on diseases that affect farm animals.

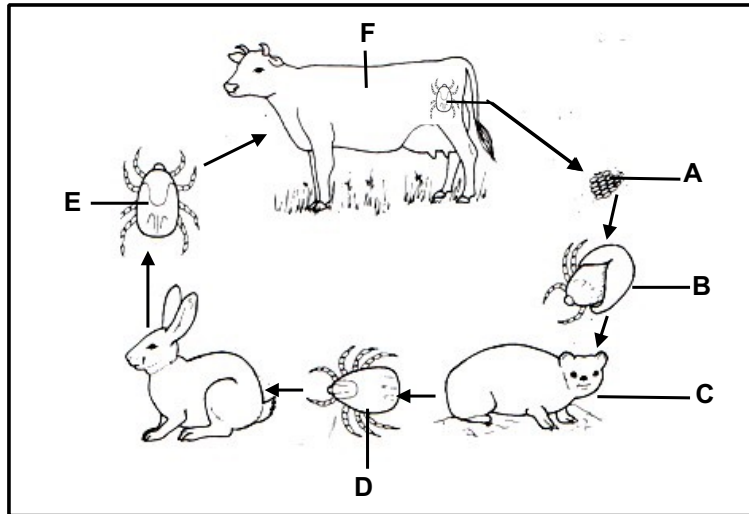
DISEASE	PATHOGENIC AGENT	KEY SYMPTOMS	TYPE OF ANIMAL AFFECTED/INFECTED
Newcastle disease	<b>A</b>	Respiratory distress, nasal discharge and death	Poultry
<b>B</b>	Bacteria	Infected udder swollen, hot and painful	Lactating farm animals
Coccidiosis	Protozoa	Diarrhoea, dehydration and weight loss	<b>C</b>
Lumpy wool	Fungus	<b>D</b>	Sheep

13.1.1 Complete the table above by providing the missing information for **A**, **B**, **C** and **D**. (4)

13.1.2 Name TWO preventative measures to reduce the spread of Newcastle disease. (2)

13.1.3 Give TWO financial implications of animal diseases. (2)

13.2 The diagram below indicates various stages of the life cycle of a parasite in farm animals.



13.2.1 Write down the letter (**A–F**) that represents each of the following stages in the life cycle of the parasite in the diagram above:

- (a) The larvae that hatches from the egg
- (b) The nymph that will feed on the second host
- (c) The tick that will feed on the third host
- (d) The first host after the larvae stage

(4)

13.2.2 Metallic salts can be toxic and poisonous if consumed in excess by farm animals. Precautionary measures should be taken to avoid the risk of poisoning.

Indicate TWO symptoms of urea poisoning.

(2)

MAIN TOPIC	SUGGESTED CONTENT
<b>Animal reproduction</b>  <b>Male and female reproductive systems</b>	<b>Reproductive organs of cattle</b> <ul style="list-style-type: none"> <li>• Distinguish between the primary and secondary male reproductive organs/structures</li> <li>• List the functions of the testes, epididymis, scrotum and the accessory sex glands (vesicular glands; prostate; Cowper's gland)</li> <li>• Describe the process of sperm formation (spermatogenesis) and make a schematic representation of spermatogenesis</li> <li>• State the factors causing sterility and infertility in bulls</li> <li>• Identify and describe the primary and secondary female reproductive organs (structure)</li> <li>• Indicate the functions of the ovaries, Fallopian tubes, uterus and vagina</li> <li>• Describe the process of ovogenesis/oogenesis and make a schematic representation of ovogenesis/oogenesis</li> </ul>
<b>Oestrus and oestrus cycle</b>	<ul style="list-style-type: none"> <li>• Define oestrus or the heat period</li> <li>• Identify and describe the female sex hormones and their respective functions</li> <li>• Indicate and describe the periods/stages/phases of the oestrus cycle in cows</li> <li>• Noticeable signs/characteristics of oestrus in cows</li> <li>• Describe the practical methods dairy farmers can adopt to assist with the identifying of cows on heat</li> </ul>
<b>Synchronisation of oestrus and mating</b>	<ul style="list-style-type: none"> <li>• Define the concept of the synchronisation of oestrus/heat</li> <li>• Briefly describe the various techniques/methods of synchronisation of oestrus/heat</li> <li>• Advantages and disadvantages of synchronisation of oestrus</li> <li>• Describe the basic factors causing sterility and infertility in females (cows)</li> <li>• Define mating/copulation and ejaculation</li> <li>• Describe natural mating by referring to male sexual display/courtship behaviour/pattern, factors that regulate mating behaviour among bulls and the five main stages of mating/copulation</li> </ul>



MAIN TOPIC	SUGGESTED CONTENT
<b>Artificial mating (artificial insemination, embryo transplantation and cloning)</b>	<p>Define artificial insemination</p> <p>Indicate the main requirements for successful AI ; List the advantages and disadvantages of AI</p> <p>Describe the collecting of semen by using an artificial vagina or electrical stimulation/electro-ejaculator</p> <p>State the basic requirements for semen collection and storage ; Describe the characteristics of good quality semen (semen evaluation)</p> <p>Describe the dilutants and functions of such dilutants ;Identify the correct time for artificial insemination (timing for AI)</p> <p>Indicate and describe the correct technique for carrying out AI</p>
<b>Embryo transplantation/ transfer (ET)</b>	<p>Identify and define embryo transplantation/transfer (ET), super ovulation, embryo flushing/harvesting, donor cows, recipient cows</p> <p>Describe the aims/purposes of ET and embryo flushing/harvesting</p> <p>List the advantages and disadvantages of ET</p>
<b>Nuclear transfer (Cloning)</b>	<p>Define nuclear transfer/cloning</p> <p>List the aims/purposes of animal cloning</p> <p>Distinguish between reproductive cloning and therapeutic cloning</p> <p>Indicate the advantages and disadvantages of cloning</p>
<b>Fertilisation and pregnancy</b>	<p>Identify and define fertilisation, pregnancy/gestation, freemartins and placenta Describe the fertilisation process</p> <p>Describe the formation of multiple births (twins) and freemartins</p> <p>Identify the phases/stages of pregnancy</p> <p>Give the main reasons for abortions</p>
<b>Birth/Parturition and dystocia</b>	<p>Define parturition/birth and dystocia</p> <p>Signs/Characteristics of a cow approaching parturition</p> <p>State the functions of the layers covering the foetus</p> <p>Indicate the stages/phases of parturition</p> <p>Identify and describe the correct birth positions of a calf in the uterus just before birth</p> <p>Name the conditions which interfere with normal parturition process</p> <p>Describe the principal factors causing the retention of the placenta/afterbirth in cows</p>
<b>Milk production/ Lactation</b>	<p>Identify and define the lactation, dry period and milk ejection</p> <p>Identify and describe the structure of the udder of a cow (functions)</p> <p>Discuss the milk ejection/milk let down process and hormones involved</p> <p>Explain the importance and functions of colostrum for the new born calf</p> <p>Identify and describe the interpretation of the lactation curve and lactation cycle (period)</p>

# ANIMAL REPRODUCTION

## Functions of Testosterone

- Development of secondary sex characteristics
- Normal mating behaviour
- Production and transport of sperms

## Functions of scrotum

- Protects the testes
- Regulates temperature

## FUNCTIONS OF ACCESSORY GLANDS

- 1. Vesicular glands (seminal vesicles)**
  - Provide more than half of the total fluid volume of semen.
  - protect the semen against changes in pH.
  - provide energy for the sperm.
- 2. Prostate**
  - gives semen its characteristic smell.
  - maintain the correct pH of semen
- 3. Bulbo-urethral/ (Cowper's glands)**
  - maintains the correct pH of semen
  - lubricates and cleanses the urethra before ejaculation
  - improves the motility of sperm during

## Factors that cause infertility in BULLS

### 1. Lack of libido (sex urge)

- |                     |                 |
|---------------------|-----------------|
| • Sexual immaturity | • Malnutrition: |
| • inexperience      | • Disease:      |
| • Exhaustion:       | • Old age       |

### 2. Impotence (inability to copulate)

- |  |                                     |
|--|-------------------------------------|
| • Conformation abnormal (hind legs short): | • Congenital Deformities(corkscrew) |
| • Diseases:                                | • Injuries:                         |

### 3. Sterility

- |                 |                            |
|-----------------|----------------------------|
| • Climate:      | • Congenital defects(HHSC) |
| • Malnutrition: | • Infection in sex organs: |
| • Disease:      |                            |

## BULL

### 1. Testes (primary)

- Produce sperms
- Produce testosterone

### 2. Epididymis

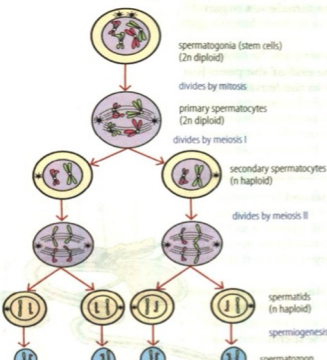
- Storage, Maturity, Transportation of sperms

### 3. Vas deferens

- Transports sperms

### 4. Urethra

- Transports semen & urine
- 5. Penis

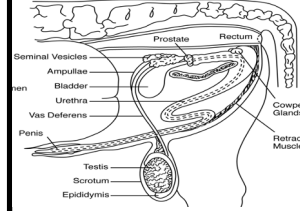


## Factors regulating mating in bulls

- Pheromones ✓
- Sight ✓
- Experience ✓

## Sexual behavioural signs of a bull

- Resting the bull's chin on the cow's rump ✓
- Flehmen response/ Bull extends its head and curl upper lip ✓
- Bull follows / excited about the cow on oestrus
- Bull smell and lick genitalia and urine of the cow ✓
- Pawing on the ground and snorting by the cow ✓
- Bellowing and tongue lapping ✓



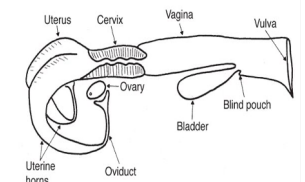
# Bull & Cow

**Stages of mating**  
**Courtship** – Pheromones  
**Mounting**- with front legs  
**Copulation**-insert penis  
**Ejaculation**-release semen  
**Dismounting**-gets down

## COW

### 1. Ovaries (primary)

- Produces ova
- 2. Oviducts (fallopian tubes)
  - Transports ova
  - Site of fertilisation
- 3. Uterus
  - development of the foetus
- 4. Cervix
  - barrier during pregnancy
- 5. Vagina – for copulation; birth canal
- 6. Vulva – pass urine



## Definition of oestrus cycle

Hormonally controlled recurring periods of oestrus alternating with sexual rest

## Stages of Oestrus cycle

- 1. Pro-oestrus**  
2-3 days - FSH
- 2. Oestrus**  
18 hrs - oestrogen
- 3. Met-oestrus**  
3 days - LH  
CL - Progesterone
- 4. Di-oestrus**  
15 days  
Progesterone and later Prostaglandin

## Signs of oestrus

- Mounts other cows
- Restlessness
- Loss of appetite
- Swelling of the vulva
- Mucus secretion in vulva
- Vagina is red and moist
- Scratches, manure and mud on the rear end.
- Tail/rump hair is fluffed up
- Raised tail
- Milk production decreases

## Functions of hormones

- 1. FSH**
  - Growth of follicles
- 2. Oestrogen**
  - Signs of oestrus
  - Prepare for implantation
- 3. LH**
  - Rupturing of Graafian follicles/ for ovulation
  - Formation of corpus luteum
- 4. Progesterone**
  - Inhibit FSH secretion
  - Stop secretion of oestrogen
  - Maintains pregnancy
- 5. Prostaglandin**
  - To destroy corpus luteum
- 6. Prolactin/ LTH**
  - For milk synthesis
- 7. Oxytocin**
  - Contract myoepithelial cells
  - For milk let-down
- 8. Adrenalin**
  - Inhibits milk release
- 9. GnRH**

## Synchronisation of oestrus

-Manipulation of oestrus cycle of cows to come to oestrus same time  
**Methods & Hormones**

1. Inject with Prostaglandin
2. Inject with Progesterin
3. Inject with estradiol
4. Inject with GnRH
5. MGA – mixed with feed
6. Intra-vaginal implants

## Advantages of Synchronisation of oestrus

- Short breeding season,
- Simplifies management

## Disadvantages of Synchronisation of oest

- Expensive
- Needs expertise

## Practical methods to detect oestrus

**Observation** of the cow's behaviour .  
 Bulls marked with a 'chin ball marker'

### Heat mount detectors

**Tail paint** is put on the tail head

**Pedometer** is strapped in lower leg

**Vasectomised bulls** used to detect heat

PHASES	DURATION	HORMONES
Pro-oestrus	2-3 days	FSH
Oestrus	18 hours	Oestrogen
Met oestrus	3 days	LH , progesterone
Di-oestrus	15 days	CL, progesterone

**Anoestrus:** the cow does not exhibit normal oestrus cycles.

# ANIMAL REPRODUCTION

**Embryonic transfer** involves removing the fertilised ovum (EMBRYO) from the uterus of a genetically superior cow (DONOR) and transferring it to the uterus of a genetically inferior cow (RECIPIENT) where the calf then develops until

## KEY TERMS of ET

**Superovulation:** more than one ovum being released at ovulation.

**Embryo flushing/harvesting:** the fertilised ovum, or embryo, is removed from the donor animal

**Donor:** the animal from which the ovum or embryo is harvested.

**Recipient:** the animal that receives the harvested ovum or embryo.

## TWO benefits of ET to farmers

- More progeny produced from best cows
- Reproductive rates of valuable cows increased
- More profit
- Fast genetic improvement of the herd
- Productive life of older cows is extended
- Genes in a herd are conserved/prevent extinction of valuable animals

## METHOD OF EMBRYO TRANSFER

- **Step 1** The oestrus cycle of the donor and many recipients are synchronised.
- **Step 2** The donor is treated to superovulate and is artificially inseminated.
- **Step 3** One week after insemination the fertilised ova are washed from the donor's uterus using a special salt solution.
- **Step 4** Embryos are microscopically evaluated to select the best embryos for implantation.
- **Step 5** Viable embryos are transplanted to

## ADVANTAGES OF ET

- Fast genetic improvement in a herd.
- Extend reproductive life of older cows
- The number of offspring obtained from superior animals is multiplied.

## DISADVANTAGES OF ET

- It is expensive
- Requires expertise/skill
- Time consuming – many steps
- May spread diseases

## Nuclear transfer (NT), also called cloning.

Cloning is transferring the donor nucleus into an **ovum** to make an **exact copy** of donor.

## STEPS OF NUCLEAR TRANSFER

1. A somatic cell nucleus is taken from a donor.
2. An egg cell/ovum is taken from a female sheep
3. The nucleus of the ovum is removed (enucleation)
4. The donor nucleus is transferred into an egg cell that has its nucleus removed.
5. Electric current is then used to fuse the cells.
6. The resultant embryo is then placed in the uterus of a surrogate mother where it grows.

## Types of cloning

1. **Reproductive cloning** – embryo implanted in uterus to produce offspring (exact copy of donor)
2. **Therapeutic cloning** – embryo stem cells are used for research.

## The purpose of NT

- Mass-produce organisms with desired qualities.
- Cloning animals for medical purposes
- To increase the population size of endangered animals.

## 2. EMBRYO TRANSFER

## ADVANTAGES OF CLONING

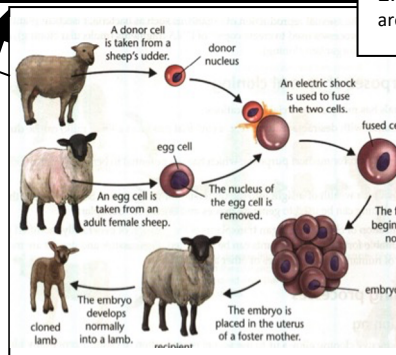
- preservation of rare & endangered species..
- Frozen cloned embryos can be stored
- Many clones from one female.

## DISADVANTAGES OF CLONING

- It is expensive
- Large offspring cause dystocia
- Clones have short lifespan

## REPRODUCTIVE TECHNIQUES

## 3. NUCLEAR TRANSFER



## GESTATION

## PARTURITION

### TWO causes of Dystocia /Birth problems

- ✓ Large foetus/small sized heifer
- ✓ Multiple birth
- ✓ Inexperience
- ✓ Incorrect positioning
- ✓ Posterior
- ✓ Malformed foetus/hydrocephalus

### Causes of abortion in cows

- ✓ Infections/disease
- ✓ Malnutrition
- ✓ Injuries

### STAGES OF PARTURITION

- Preparatory stage
- Ejection of foetus
- Ejection of placenta

## IMPORTANT TERMS

**Pregnancy/gestation:** This is the period during which the embryo develops.

**Freemartin:** A sterile female calf born co-twin to a bull, because the blood supply of the two foetuses becomes mixed, hampering the development of the female sex organs.

**Placenta:** The placenta forms the connection between the mother and the developing embryo.

**Identical twins- one ovum, one sperm**  
**Fraternal twins -2 sperms. 2 ova**

## STAGES OF PREGNANCY

- Ovum stage
- Embryo stage
- Foetus stage

## Causes of placenta retention

- Malnutrition
- Sexually Transmitted Diseases
- Exhaustion
- Abortion

## 1. ARTIFICIAL INSEMINATION

### Methods to collect semen

- Artificial vagina
- Electrical stimulator

### Semen evaluation

#### Macroscopic

1. **Colour**
  2. **Density**
  3. **Volume**
- Milky, sticky, volume of 4ml

#### Microscopic

1. **Motility** – 80% mobile
2. **Sperm count** – No of sperms per ml
3. **Viability** – < 20 % abnormal sperms

### Functions of the Dilutant

- Buffers control the pH of diluted semen
- Lipids protect sperms from cold shock.
- Nutrients provide energy for the sperm.
- Antibiotics protect the sperm from bacterial growth.
- Glycerol protects the sperm from freezing

### Requirements of AI

- Correct timing
- Use of viable semen
- Used skilled inseminator
- Use the correct sterilised equipment

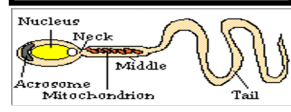
### Advantages of AI

- Preventing spread of diseases
- Economical breeding method
- Rapid genetic improvement
- Use semen from overseas bulls

### Disadvantages of AI

- Injuries by inexperienced inseminator
- Needs expertise/skill
- It is Expensive
- Heifers are difficult to inseminate

## Fertilisation & Conception



Mating/AI usually occurs before ovulation, so sperm arrive in the fallopian tubes –before–the release– of the– ovum. Sperm can stay alive and-viable for 24-48 hours in the uterus or fallopian tubes.

The sperm approach the **zona pellucida** of the egg cell to penetrate.

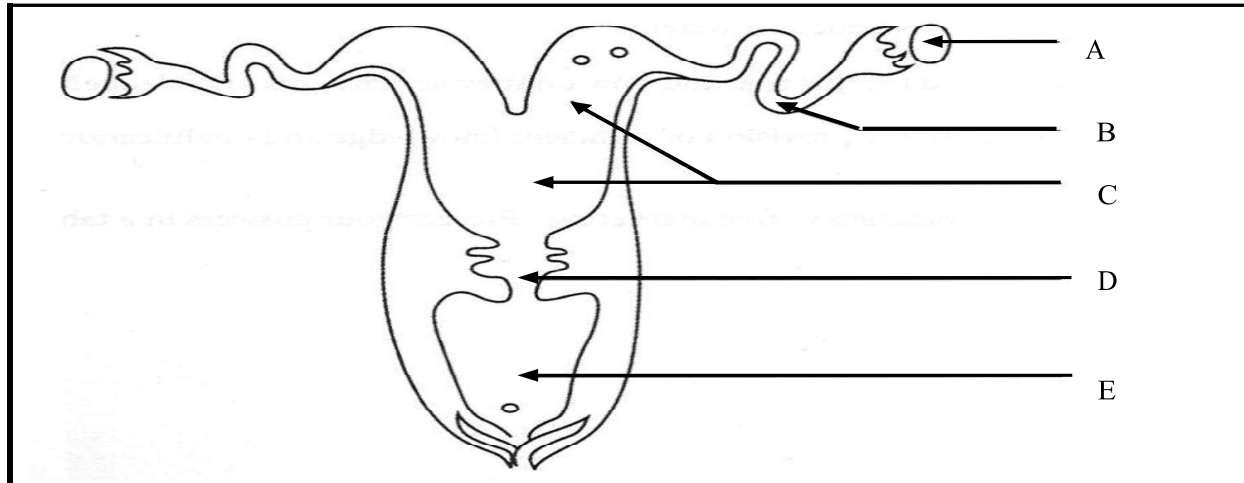
The acrosome reaction is a structural change of the head of the sperm that release the enzyme **hialurodinase** from the acrosome. These enzymes dissolve the covering of the ovum so that the sperm can penetrate.

Since a large quantity of enzymes is required to dissolve the wall of the ovum, a few million sperms are required to ensure fertilisation.

Thereafter, the ovum becomes impenetrable to other spermatozoa. The head of the spermatozoon fuses with the nucleus of the ovum to form a diploid zygote. The

## QUESTION 1

1.1 The diagram below shows the reproductive system of a female farm animal.



1.1.1 Write down the letters (A E) that represent TWO secondary sex organs in the diagram above. (2)

1.1.2 Write down the letter (A E) that represents the part where EACH of the following occurs:

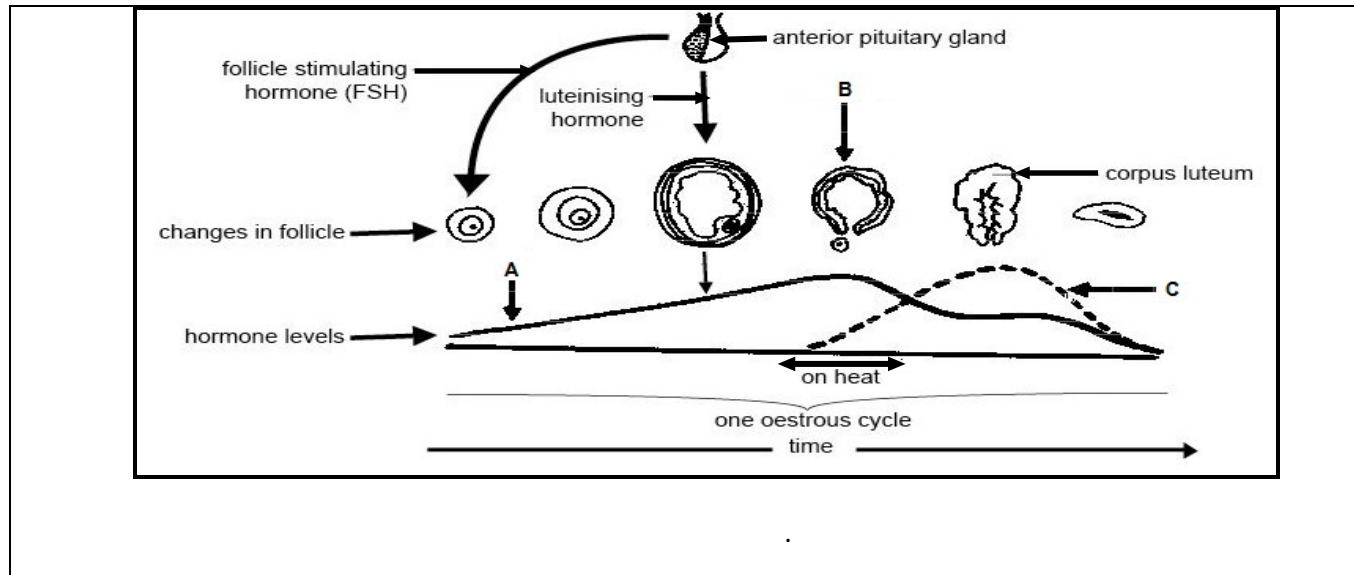
- (a) Fertilisation (1)
- (b) Secretion from these glands provides nutrients for developing embryos (1)

1.1.3 State the function of D under the following conditions:

- (a) During mating (1)
- (b) During pregnancy (1)

## QUESTION 2

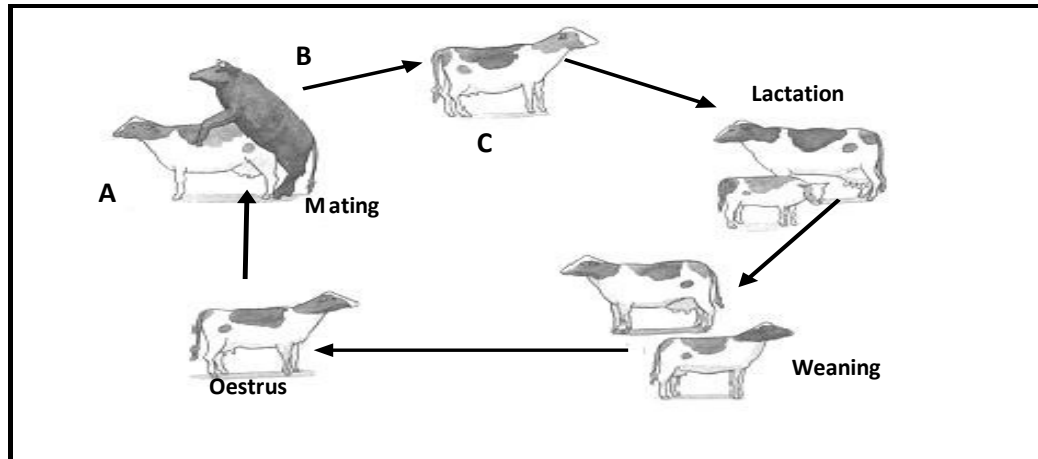
2.1 The schematic representation below indicates the sequence of hormone levels resulting in changes that occur during the oestrus cycle as well as some structures involved.



- 2.1.1 Identify hormone A and hormone C. (2)
- 2.1.2.2 Explain the process at B. (2)
- 2.1.3 Briefly describe TWO visible signs that the cow will display when hormone A is at its peak. (2)
- 2.1.4 State the main function of FSH in the schematic representation above. (1)

### QUESTION 3

3.1 The picture below shows the reproductive cycle in cattle.



3.1.1 Identify the hormones that initiated mating by animal **A** and animal **B**. (2)

3.1.2. Give a function for EACH hormone in QUESTION 4.1.1 secreted by animal **A** and animal **B**. (2)

3.1.3 Identify the following reproductive processes:

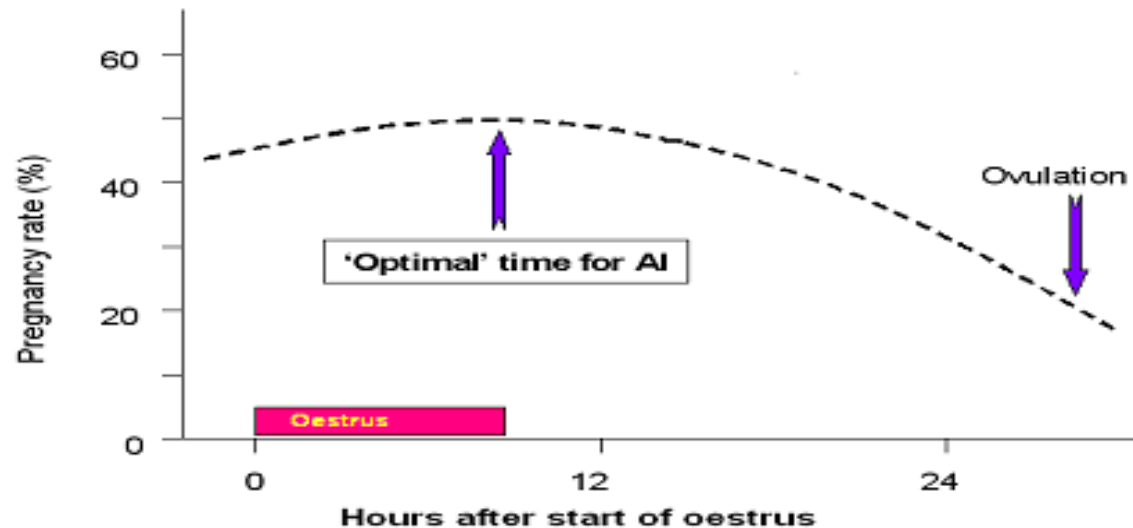
- (a) **C** after successful action by animal **A** and animal **B** (1)
- (b) Between **C** and lactation (1)

3.1.4 Name the hormone that initiates milk let-down. (1)

3.1.5 Indicate how the hormone in QUESTION 4.1.4 functions in milk let- down. (1)

#### QUESTION 4

4.1 The graph below shows the pregnancy rates and oestrus of cows.



4.1.1 Identify the hours after oestrus when the highest pregnancy percentage rate may be achieved. (1)

4.1.2 Give a reason why an inseminator can inseminate the cow between the first hour and 12 hours after the start of oestrus. (1)

4.1.3 State TWO visible signs showing that the cow is in oestrus. (2)

4.1.4 Give ONE reason why a cow is inseminated hours before ovulation. (1)

4.1.5 Indicate ONE requirement of a successful insemination. (1)

## Question 5

The correct technique must be used during artificial insemination (AI) to minimise the risk of injuring an animal.

Below are the steps that should be followed when artificial insemination is done:

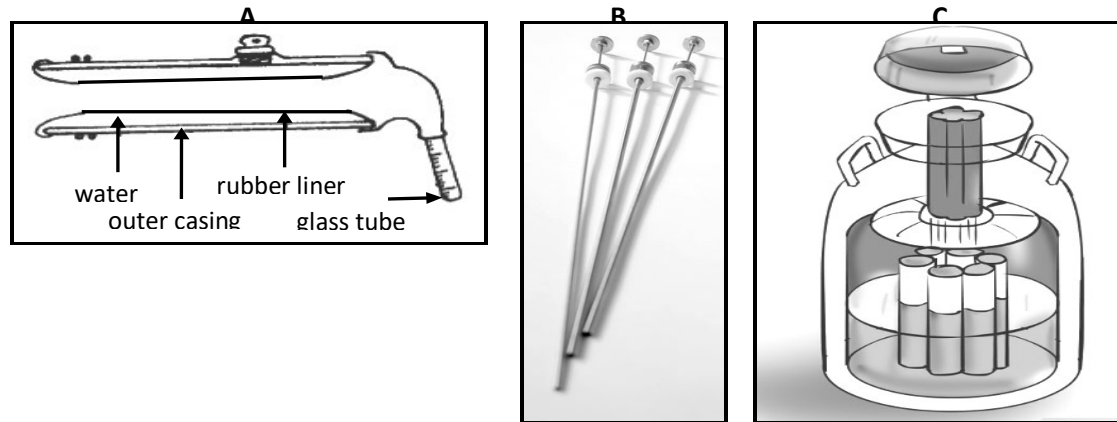
- The inseminator feels for abnormalities and whether the cow is not already pregnant by inserting the hand into the rectum.
- The pistolette is guided through the vulva, vagina, cervix to the uterus..
- A cow is sheltered and kept calm.
- Excess faecal matter is removed.

- 5.1.1** Rearrange the steps of AI above into correct sequential order. (3)
- 5.1.2. Suggest the purpose of using the pistollete during AI. (2)
- 5.1.3. Deduce the reason for depositing semen in the uterus instead of cervix. (2)
- 5.1.4 Name the TWO advantages of Artificial insemination. (2)
- 5.1.5. Indicate the main purpose of using dilutants such as egg yolk, glycerol etc. . (1)



## QUESTION 6

6.1 . The diagrams below show different apparatus that are used in the process of artificial insemination (AI).



- |       |   |     |
|-------|---|-----|
| 6.1.1 | Identify apparatus A, B and C above                                 | (3) |
| 6.1.2 | State the main function of apparatus A, B and C.                    | (3) |
| 6.1.3 | Name TWO basic requirements for the collection of semen from bulls. | (2) |
| 6.1.4 | Suggest THREE substances that can be used as dilutants for semen.   | (3) |

## QUESTION 7

7.1 The representation below shows a process used in female farm animals.

Scheduled process:

- Day 1–14: melengestrol acetate (MGA in feed)
- Day 33: inject with prostaglandin

~~1–2–3–4–5–6–7–8–9–10–11–12–13–14–15–16–17–18–19–20–21–22–23–24–25–26–27–28–29–30–31–32–33–34–35–36–37–38–39–40~~

(days of the schedule)

7.1.1 Identify the process above. (1)

7.1.2 State TWO disadvantages of the process in QUESTION 4.5.1. (2)

7.1.3. State TWO disadvantages of the process in QUESTION 4.5.1. (2)

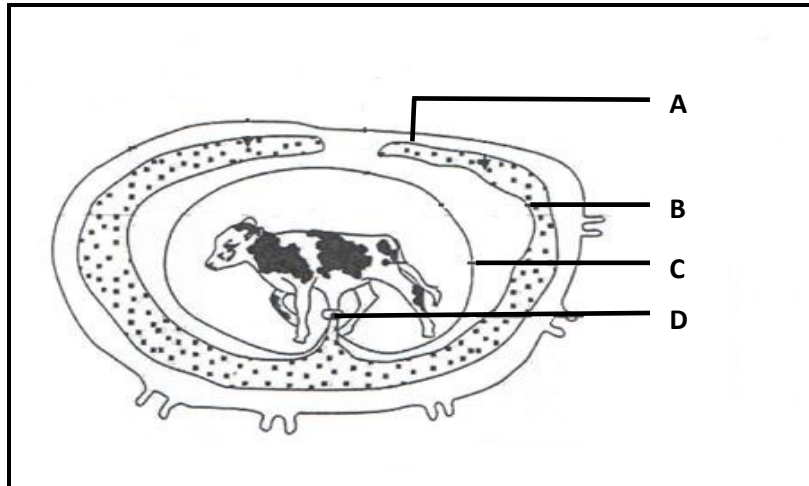
7.1.3 Name TWO other techniques not mentioned in the schedule above, that can also be used in female animals. (2)

4.3.6 Assuming that the above-mentioned schedule is properly followed, identify the day on which the cows will be inseminated. (1)

7.1.5 Name THREE causes of the lack of libido in male farm animals. (3)

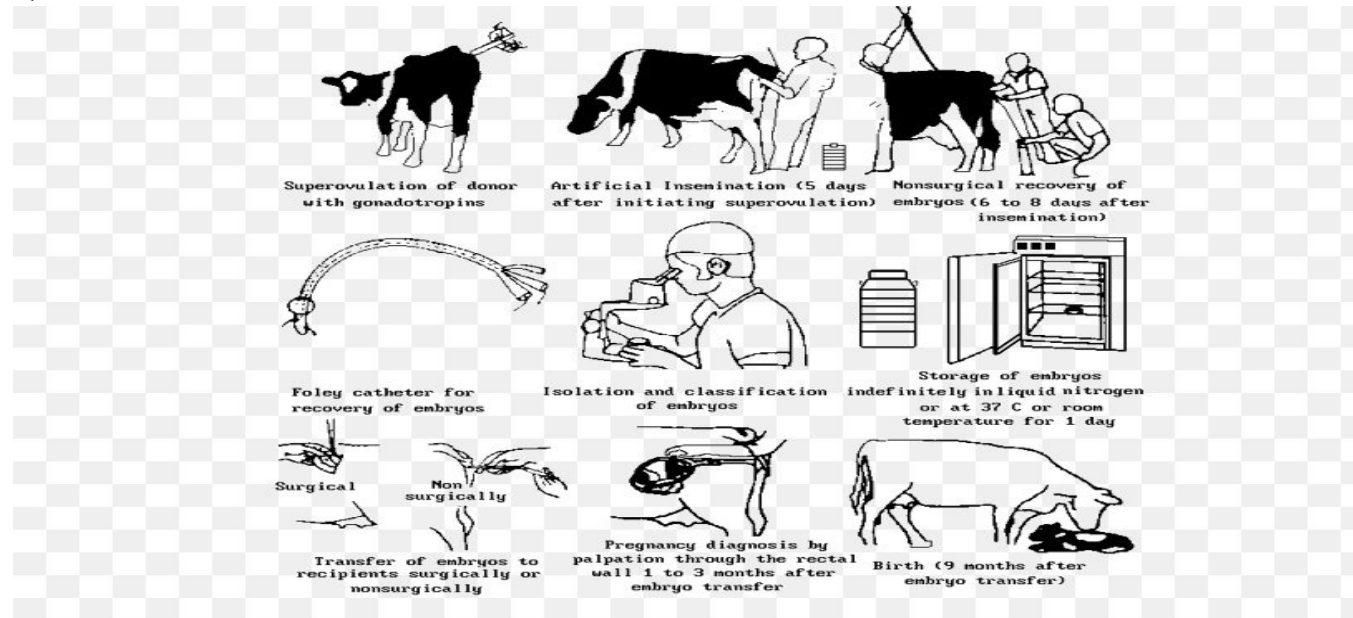
### QUESTION 8

The diagram below shows the layers covering the foetus during pregnancy.



- 8.1.1 Name the stage of pregnancy in the diagram above. (1)
- 8.1.2 Write down the letter of the membrane responsible for EACH of the following:
- (a) Attaches the foetus to the uterus (1)
  - (b) Collects the urine of the unborn calf (1)
  - (c) Protects the unborn calf from injuries (1)
- 8.1.3 State TWO behavioural signs of an animal that is about to give birth. (2)
- 8.1.4 Name TWO causes of problems during birth in heifers. (2)

Question 9



9.1.1 Identify the process above.

9.1.2 Identify the first three techniques of the process above after synchronising the oestrus cycles of the donor and the recipients. (3)

9.1.3 Suggest the part of the cow in technique (step) No.3 where embryos are recovered. (1)

9.1.4 Indicate the purpose of a microscope in the process above. (1)

9.1.5 Deduce TWO purposes of using the black and white cow in the process above. (1)



**TOPIC 6 Page 135**  
**Agric-economic  
 production factors**

**UNIT 1 Page 136**  
**Land as an agric-  
 production factor**

- The concept: land
- The functions of land (in economic terms)
- Economic characteristics of land as a production factor
- Techniques or methods to increase land productivity

**UNIT 2 Page 139**  
**Labour as an agric-  
 production factor**

- The term: labour
- Different types of labour in agriculture
- Problems associated with labour in agriculture
- Methods of increasing labour productivity
- Labour legislation Acts in South Africa
- Standard format and layout of farm worker contracts

**UNIT 3 Page 143**  
**Capital as an agric-  
 production factor**

- Terminology: capital, assets, cash flow, budgets
- Types of capital
- Methods of creating capital
- Sources of finance/credit
- Problems associated with capital as a production factor
- Capital/financial management systems
- Enterprise and whole farm budgets
- Components of a cash flow statement
- Main aspects of a cash flow budget statement

**UNIT 4 Page 149**  
**Management as an  
 agric-production factor**

- The concept: farm management and strategic farm risk management
- The principles/components of management
- Management skills needed to manage a farm business
- Internal and external forces that affect/influence farming businesses
- Primary sources of risk in farming businesses
- Main risk management strategies/techniques

### Economic functions of soil

- Provides space
- Supplies raw materials
- Supplies food
- Supplies raw materials
- Asset used as collateral in funding

### Economic characteristics

- Availability is limited- Urbanisation
- Differences in production potential
- Durability
- Indestructibility
- Restrictedness
- Specific environment
- Subject to law of diminishing returns
- Value increases (appreciates) over

### Principles / components of management

- **Managerial principles**
  - Planning, - Implementation
  - Control, - Decision making
  - Organising & coordinating
  - Communicating, - motivating
  - Leading or directing
  - Monitoring, -Controlling
- **Components of strategic management**
  - developing a vision
  - developing a mission
  - setting goals
- **Development of business strategies**
  - Consider external business environment
  - SWOT analysis
  - Consider mix of enterprises
  - Consider enterprise strategies

**Sources of risk:** Technological skills, Production risks, Market or price risks, Financial risks, Climate risk, Political risk, Health risk

**Risk management strategies:** Insurinsurance, diversification, risk sharing, specialisation, Hedging, on farm-processing, ensuring flexibility, contract production.

### Increasing soil /land productivity

- Improving Water management- drip irrigation
- Consolidation of uneconomical units -
- Changing cropping practices- crop rotation
- Restoring land potential
- Farming land more efficiently / Soil analysis
- Use scientific methods/Precision farming/fertilizers

### Law of diminishing returns

- If you add successive units of an input/variable, output will increase until a point where returns will start to decline.
- If you continue to add input, you will not get a proportional increase in yield.
- Soil has a max production capacity

## LAND

### Forces affecting business

- **Internal** – resources, farm financial position, competencies of workforce, quality of products
- **External** – economic forces, political forces, legal, ethical, socio – cultural forces

## MANAGEMENT

### Management skills

- **General business management skills**
  - Conceptual , Analytical skills
  - Planning skills, Problem solving & decision making, Organisational skills
- Entrepreneurial skills, Ability to adapt
- **Financial management skills**
- **Interpersonal & communication skills**
- **Problem solving skills**
- **Decision making skills**
- **Production & operation skills**

### Types of labour - according to contract

- Permanent – full-time (work ordinary hours)
- Temporary – not permanently employed e.g.
  - Casual – work less than 24 hrs p/m
  - Part-time - (less than ordinary hours)
  - Seasonal – peak periods(e.g. harvesting,

### Labour problems

- Shortage of labour/ Scarcity of skilled labour
- Industrial competition
- Lack of skills
- Poor labour management
- HIV /AIDS
- Low income

### Types of labour based on skill

- Skilled – e.g. nutritionists
- Semi-skilled- e.g. Driver
- Unskilled - e.g. harvesters

## AGRICULTURAL PRODUCTION FACTORS

### Creation of capital

- Production profit from operations
- Savings
- Credit , loans, grants

### Types of capital- credit/period

- Fixed capital –Long term credit (10-30yrs)
- Movable capital -Medium term credit(2-9 yr)
- Working capital –short term credit(less 2 yr)

### Sources of finance

- Commercial banks e.g ABSA, FNB
- Financial institutions e.g. Land Bank
- A trust company
- Agricultural Cooperatives

## LABOUR

### Increasing labour productivity

- **Increasing economic conditions of workers**  
e.g., *incentives, high wages, bonuses, medical aid*
- **Improving educational conditions**  
e.g.(Training, skills development, workshops)
- **Improving environmental conditions**  
e.g.(better housing, facilities to socialise, clean water)
- **Improving working conditions**  
e.g.(*Protective clothing, supervision, Leave days*)
- **Economic, Daily and Physical farm Planning**
- **Addressing HIV/AIDS**  
e.g.(Awareness, give medication, condoms, abstain)
- **Efficient mechanisation**

### Labour legislation

- Labour Relations Act- *labour disputes, unions*
- Basic Conditions of Employment Act- (*wages, working hrs, leaves, overtime*)
- Occupational Health and Safety Act
- Compensation for occupational injuries and Diseases Act (*payment if injured / very ill*)
- Skills Development Act- (*train workers*)

### Labour contracts

- Employer & employee details
- Place of work
- Conditions of termination
- Wages, allowances, benefits
- Working hours
- Signatures

## CAPITAL

### Problems associated with capital

- Scarcity
- High risk
- Depreciation
- High interest rates
- Under/overcapitalisation

### Components of a cash flow statement

- Income
- Expenditure
- Profit or loss
- Opening balance
- Closing balance
- Contains only cash items

### Financial Management Systems

- Keeping the records
- Keeping inventory of assets
- Keeping cash analysis book
- Preparing a balanced sheet
- Preparing an income statement

### Budget types

- **Enterprise budget** caters for one enterprise at a time
- **Whole farm budget** caters for all farm enterprises

**Cash flow statement**-shows flow of cash in or out of business for a specific period.

**Income statement**- summary of all income and expenditure for a given period.

## TOPIC FOUR AGRICULTURAL PRODUCTION FACTORS

### QUESTION ONE

1.1 Match the following economic characteristics of land with the statements below. Write down only the question number and the answer, e.g. 1.1.2 durability.

**specific environment; durability; indestructibility; availability; restrictedness**

- |        |   |     |
|--------|---|-----|
| 1.1.1  | The life of soil is unlimited if used correctly.        | (1) |
| 1.1.2  | Only 12% of the soil in South Africa can be cultivated. | (1) |
| 1.1.3  | Soil may be damaged but cannot be destroyed.            | (1) |
| 1.1.4. | Land is fixed   | (1) |
| 1.1.5. | Land restricts certain types of plants                  | (1) |

1.2. The table below represents two groups of farmers with different ways of farming.

GROUP A	GROUP B
<ul style="list-style-type: none"><li>• 20 small pieces of land</li><li>• Average size of 1 ha per farmer</li><li>• 2 small tractors, others use oxen</li><li>• 1 hand sprayer</li><li>• Grows different crops per growth season</li><li>• Harvests by hand</li><li>• Combined harvest is 1 ton per hectare</li></ul>	<ul style="list-style-type: none"><li>• 576 ha arable land</li><li>• 1 big tractor, a boom sprayer and a combine harvester</li><li>• Grows maize practising a monoculture system</li><li>• Produces 5 tons per hectare</li></ul>

- 1.2.1 Indicate the land factor described in EACH of the two scenarios. (1)
- 1.2.2 State TWO benefits of the practices by the farmers in GROUP B that may have contributed to the higher production per hectare. (2)



- 1.2.3 Suggest TWO techniques applicable to the farmers in GROUP A that can improve their production per hectare. (2)
- 1.2.4 Identify an economic characteristic of land that will be negatively affected by monoculture and continuous cultivation. (1)
- 1.2.5 State TWO functions of land as a production factor.

## QUESTION 2

- 2.1 Explain the meaning of each of the following economic characteristics of land:
- a) Urban development (1)
  - b) Land is limited (1)
  - c) Land is subject to the law of diminishing returns (1)
- 2.2 The table below shows the amount of fertiliser applied and quantity of maize produced on a piece of land.

FERTILISERS (kg)	MAIZE (bags)
5	10
10	25
15	35
20	40
25	40

- 2.2.1 Draw a line graph using the information in the table above. (6)
- 2.2.2 Identify the economic characteristic of the land depicted in the table above. (1)
- 2.2.3. Describe the characteristic mentioned in Question 2.2.2 by referring to the trend shown in the graph.. (3)
- 2.2.4. Recommend the optimal input quantity to achieve maximum production. (1)

2.2.5 Deduce the function of the land reflected in the table above. (1)

2.2.6 Suggest TWO methods of increasing the productivity of the land other than the one in the table. (2)

### QUESTION 3

3.1 The table below shows a financial record showing the expected expenditure and income of a horticultural farming enterprise.

EXPECTED EXPENDITURE		EXPECTED INCOME	
ITEM	AMOUNT (R)	ITEM	AMOUNT (R)
Irrigation	10 300	Flowers (shop)	150 000
Manure	22 400	Flowers (nursery)	40 000
Fuel	13 300	Compost	7 500
Labour	24 500		
Potting soil	8 800		
Vegetative material	45 500		
Chemicals	18 700		
<b>TOTAL EXPENDITURE</b>		<b>TOTAL INCOME</b>	

3.1.1 Identify the type of financial record represented in the table above. (1)

3.1.2. Give a reason for the answer to QUESTION 3.1.1. (1)

3.1.3 Identify the horticultural farming enterprise above. (1)

3.1.4 Use a formula to calculate the profit or loss of this enterprise. (Show ALL calculations.) (4)

3.1.5 Advise if the farmer should continue the enterprise. (1)

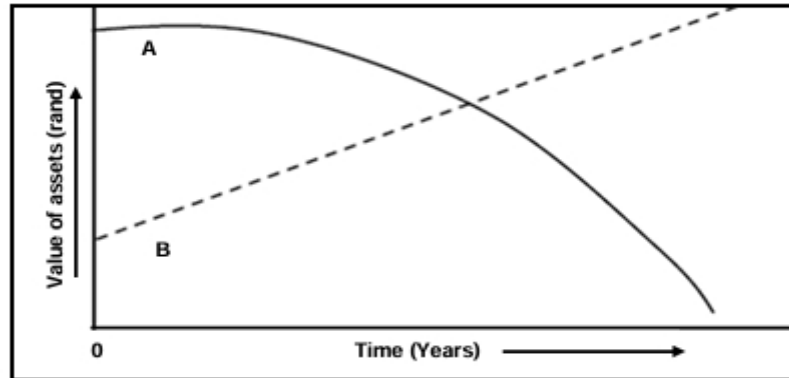
3.1.6 Provide a justification for your response to QUESTION 3.1.5 (1)

3.1.7. Determine the number of cost examples in the table that fall under each of the following categories:

(a) Fixed costs (1)

(b) Variable costs (1)

3.2 Study the line graph below and answer the questions that follow.



3.2.1. Suggest a suitable heading for the line graph above. (1)

3.2.2 Identify the curve (A or B) that represents the following:

(a) Movable capital assets (1)

(b) Fixed capital assets (1)

3.2.3 Give a reason to support the answer to QUESTION 3.2.1(b). (1)

3.2.4. Name TWO examples of movable capital assets in QUESTION 3.6.1(a). (2)

3.2.5. Advise on the type of credit to use to acquire fixed capital assets. (1)

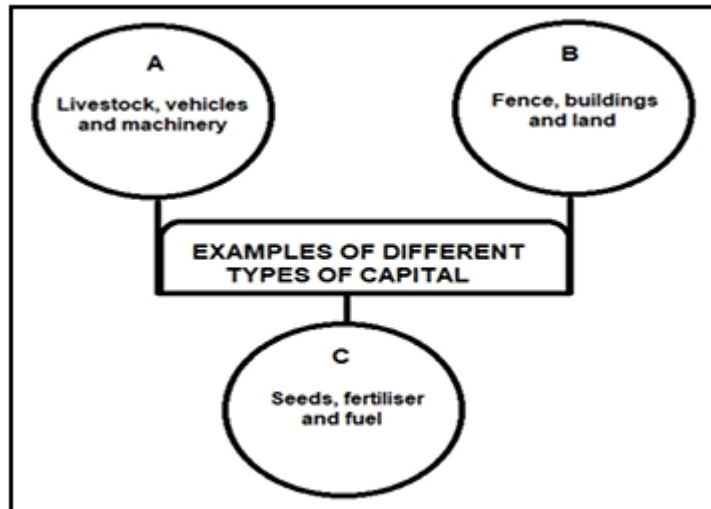
3.2.6. Name the type of capital assets that are not in the graph. (1)

3.2.7 State THREE problems of capital as a production factor. (3)

[22]

#### QUESTION 4

4.1 The diagram below shows examples of different types of capital commonly used in farming.



4.1.1 Identify the type of capital represented by A, B and C in the diagram above. (3)

4.1.2 State TWO methods of creating capital. (2)

4.1.3. Give one example of the following types of capital NOT in the diagram above:

(a) Movable capital

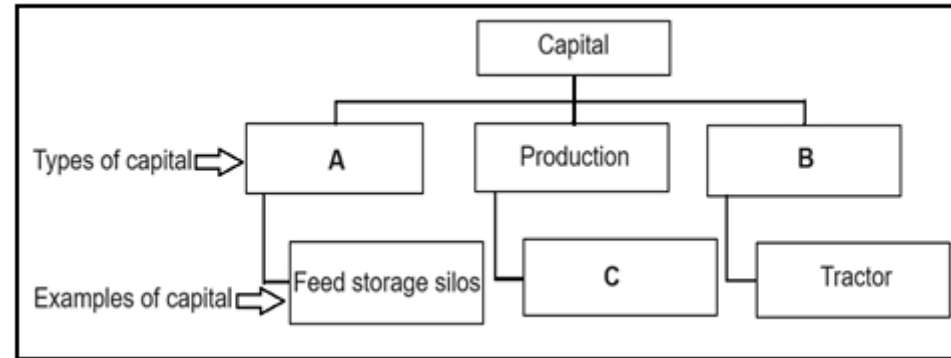
- (b) Floating/Working capital  
 (c) Fixed capital (3)  
 4.1.4. Differentiate between undercapitalisation and overcapitalisation (4)  
 4.1.5. Differentiate between depreciation and appreciation. (4)  
 4.2 The table below represents a financial record in a farming enterprise.

MONTHS OF THE THIRD QUARTER	OCTOBER	NOVEMBER	DECEMBER
OPENING BALANCE	R500	R10 150	R13 538
Income (Receipts):			
Livestock sales	R3 500	R3 500	R2 000
Sales from crops	R4 300		
Capital	R5 500	R4 500	R2 200
<b>TOTAL INCOME (RECEIPTS)</b>	<b>R13 300</b>	<b>R8 000</b>	<b>R4 200</b>
Expenses (Payments):			
Transport	R2 800	R3 700	R4 600
Interest on amount owed	R350	R412	R674
Wages for labourers	R500	R500	R3 500
<b>TOTAL EXPENSES (PAYMENTS)</b>	<b>R3 650</b>	<b>R4 612</b>	<b>R8 774</b>
<b>PROFIT/LOSS</b>	<b>R9 650</b>	<b>R3 388</b>	<b>A</b>
<b>CLOSING BALANCE</b>	<b>B</b>	<b>R13 538</b>	

- 4.2.1 Identify the financial record in the table above. (1)  
 4.2.2 Give ONE reason for the answer to QUESTION 1.2.1 by referring to the table. (1)  
 4.2.3. Show ALL calculations of how the profit of R9 650 in October was calculated. (2)  
 4.2.4 Calculate the profit or loss for December represented by A in the table above. Include the formula and show ALL calculations. (3)  
 4.2.5. Show all the steps and calculations that were used to work out the closing balance of R3 388 in November. (3)  
 4.2.6 Calculate the closing balance represented by B in the table above. Show ALL calculations (2) [30]

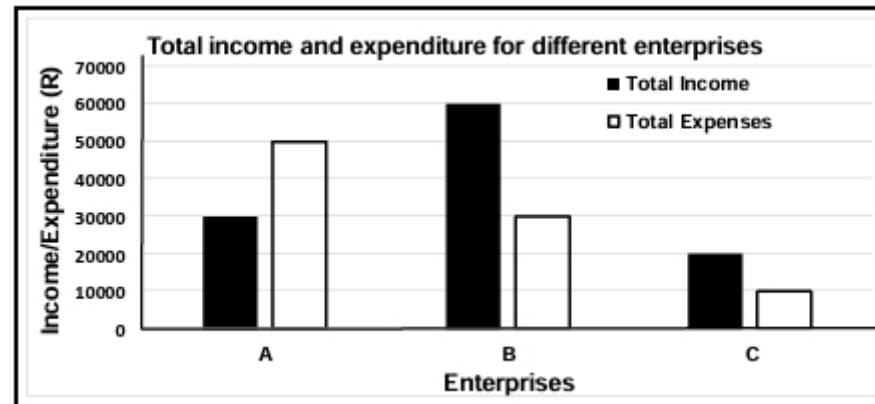
## QUESTION 5

5.1 The schematic representation below shows types of capital with examples.



- 5.1.1 Identify the types of capital represented by A and B in the schematic representation above. (2)
- 5.1.2 Give ONE example of a capital item represented by C. (1)
- 5.1.3 Suggest the type of credit that can be sourced from a financial institution to acquire the following types of capital:
- (a) A (1)
  - (b) C (1)
- 5.1.4 Name ONE method of creating capital. (1)
- 5.1.5 Mention TWO sources of capital. (2)

5.2 The graph below shows income and expenditure for different farming enterprises for the 2023/24 financial year.



5.2.1 Identify the enterprise in the graph above with the:

- (a) Highest income (1)
- (b) Lowest expenses (1)

5.2.2. Name the financial record that shows the information in the data above. (1)

5.2.3 Calculate the profit or loss for enterprise A. Show ALL the calculations, including the formula. (3)

5.2.4. Identify the most and least profitable enterprise (A, B, C). (2)

5.2 5.3 State the problem associated with capital that is applicable to EACH of the following statements:

5.3.1 The farmer does not have enough capital to buy equipment to run the farming enterprise. (1)

5.3.2 Too much capital is invested in the enterprise in relation to available land and labour. (1)

[10]

## QUESTION 6

6.1 Management is the effective combination and coordination of human, physical and financial resources to maximise profit.

6.1.1 Indicate the management principle applicable to EACH of the following statements:

- (a) The manager puts different planned activities into action (1)
- (b) Development of short- and long-term strategies based on available resources (1)

6.2 Name TWO examples of EACH of the following:

- (a) Internal force influencing farming businesses (1)
- (b) External forces affecting farming businesses (1)

**[6]**

## QUESTION 7

- 7.1
  - a) Name and explain briefly FOUR Management principles/components (12)
  - b) There are sources of risks in farming business. Mention 4. (4)
  - c) State THREE risk management strategies (3)



8.1

The farmer took the opportunity of having an orchard to start a business making jam and dried and canned fruit. The business was growing until the machinery broke down, resulting in a drop in sales. The farmer then introduced a piggery, poultry, sheep farming and sold manure to other farmers and community members.

- 8.1.1 Identify TWO sources of risks in the scenario above. (2)
- 8.1.2 Justify EACH source of risk identified in QUESTION, 1.1.1 based on the scenario. (2)
- 8.1.3 Identify the risk management strategy used by the farmer to deal with the risks identified in QUESTION 8.1.1. (1)
- 8.1.4 State ONE applicable management principle that would assist the farmer to manage the risks. (1)

## FUNCTIONS OF AGRICULTURAL MARKETING

- Packaging
- Processing
- Storage
- Transportation

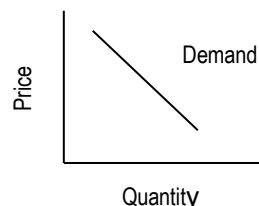
### THREE advantages of processing

- Available throughout the year
- Prevent the spoilage/wastage
- Longer shelf life
- Improves the safety of products
- More convenient/easier packaging/handling/transport
- Adds value/higher income/profit
- Provides employment
- Prevent over supply

## Demand and supply

### The law of demand

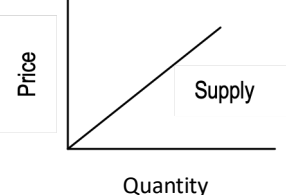
The higher the price, the less will the demand of a certain item.



## Demand and supply

### The law of supply

The higher the price, the more goods will be supplied.



## Factors affecting the demand for a product

- Price
- Quality
- Income of buyers
- Number of Consumers
- Festive seasons/ Fashion
- Substitutes/Range of products
- Complements

## Factors affecting the supply of a product

- Price
- Political instability
- Technology
- Production costs
- Subsidies
- Possibilities of increasing supply of goods

### Marketing

Emphasis is on the product  
Sales-volume oriented  
Planning is short-term  
Focuses seller needs

### Selling

Emphasis is on customer wants  
Profit-oriented  
Planning is long-term  
Focuses on the wants of buyers

## Factors that might hamper marketing

- Perishability
- Seasonal fluctuation in production
- Accidents, theft and spoilage
- Low value in relation to volume
- Poor infrastructure
- Lack of capital
- Market agents, High transport costs

## Ways to streamline and improve Agri-business chain.

- Refrigerators/Processing
- Improve infrastructure
- Access to finance
- Access to information

## Measures to prevent over supply of produce

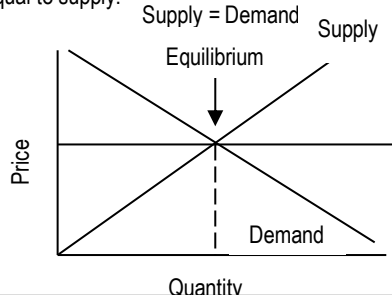
- Processing
- Building storage facilities
- Establishing new markets
- Diversification
- Hedging (contracts)
- Dumping produce
- Controlled marketing
- Reducing production
- Improving promotion and advertising of produce

## Guidelines for packaging

1. Product identification
2. Must be recyclable & biodegradable
3. Protection
4. Health risk
5. Containment

## THE MARKET EQUILIBRIUM:

- The market equilibrium is the point where the amount of product supplied by the producer is equal to the amount sought by buyers; supply is equal to demand
- **Equilibrium price:** the price at which the demand is equal to supply.



## Develop market strategy/mix

- Product
- Price
- Place
- Promoting products

## Ways of promoting the product

- Advertising/radio/television
- In-store promotion
- Marketing agent

## Principles of co-operative marketing

- Members' economic participation
- Voluntary and open membership
- Democratic member control
- Autonomy and independence
- **Advantages of Pool system**
- More bargaining power
- Risks are shared by members
- Access to funding/experts/infrastructure
- Bulk selling, Low marketing cost

# AGRICULTURAL MARKETING

## Agricultural Marketing Systems:

- **Free Market:** goods are exchanged freely no restrictions or controls

### Advantages of a free market

- Producers sell where they want
- Intermediaries are eliminated.
- Customers can bargain
- Entrepreneurship is rewarded
- Better quality products

### Disadvantages

- High risks
- High market costs
- Price fixing
- Fluctuation of prices
- Cartels are formed

## Market channels of a free market:

- Farm gate marketing – Farm stall near farm
- Fresh produce markets – uses market agent
- Stock sales – product sold to highest bidder
- Direct / contact marketing – no agent
- Internet marketing

## Sustainable Agricultural Marketing

- **Green marketing:** concern about environment
- **Eco labelling:** putting labels on products

## Advantages/Benefits of co-operative marketing

- Access to funding
- More bargaining power
- Lower marketing costs
- Better infrastructure

## Types of co-operative marketing

- Services co-operatives
- Financial co-operatives
- Consumer co-operatives
- Production co-operatives
- Marketing co-operatives

## Specification for Containment

- (a) Clean and dry
- (b) Strong and rigid
- (c) No fungus
- (d) No odour/smell
- (e) Must be suitable for the product

## Approaches to marketing:

- Niche marketing
  - Mass marketing
  - Multi-segment marketing
- M  
(dividing market into smaller groups) based on income, geography, demography, behaviour

## Levels of Market Segmentation

- Mass Marketing
- Differentiated Marketing
- Niche Marketing
- Local Marketing
- Individual Marketing

## TOPIC 5 MARKETING

MAIN TOPIC	SUGGESTED CONTENT
<b>Agricultural marketing</b>	<p>Define the market/marketing</p> <p>Distinguish between marketing and selling</p> <p>List, identify and describe the main functions of agricultural marketing (transport, storage, packaging and processing/value adding)</p> <p>Price determination and supply/demand</p> <p>Define and describe supply and demand</p> <p>Explain and interpret the law of supply and demand (the interpretation of the supply and demand curve/graph)</p> <p>Identify and explain the factors influencing the supply and demand of a product</p> <p>Identify and describe the price elasticity of supply/demand and price inelasticity of supply/demand</p>
<b>Market equilibrium</b>	<p>Define market equilibrium</p> <p>Interpret a hypothetical supply and demand curve to indicate market equilibrium Interpret the market equilibrium</p> <p>Describe the development of a market</p> <p>Describe the importance of a market with regard to fixed prices, types of buyers and methods to promote products</p> <p>List the approaches to marketing, including niche marketing, mass marketing and multisegment marketing</p> <p>Identify and explain sustainable agricultural marketing (green markets, eco-labelling)</p>

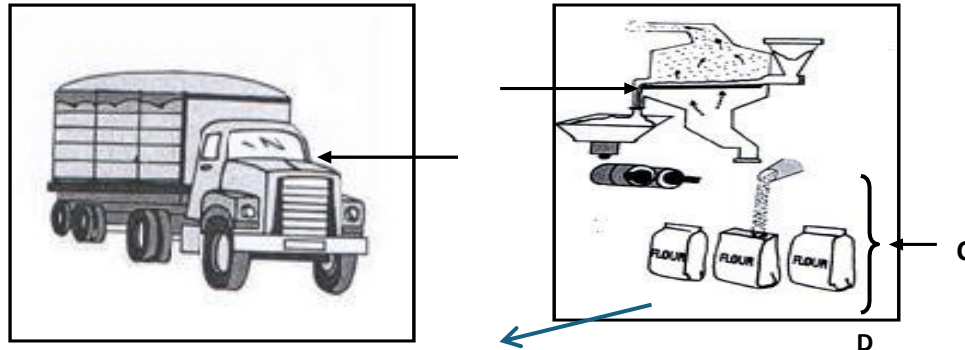
MAIN TOPIC	SUGGESTED CONTENT
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<b>Agricultural marketing systems</b>	<p><b>Free marketing</b></p> <ul style="list-style-type: none"> <li>• Define the concept of free marketing</li> <li>• Indicate the general advantages and disadvantages of a free-market system</li> <li>• Identify and describe the main channels/options of free-market systems and their advantages and disadvantages (farm-gate market, fresh-produce markets, stock sales, direct marketing and internet marketing)</li> </ul> <p><b>Co-operative marketing</b></p> <ul style="list-style-type: none"> <li>• Define the concept of agricultural co-operatives and their background</li> <li>• Describe the principles of agricultural co-operative</li> <li>• Name the types of agricultural co-operatives</li> <li>• Describe the benefits/advantages of agricultural co-operatives</li> <li>• Describe the concept of controlled marketing</li> </ul> <p><b>Controlled marketing</b></p> <p><b>Agricultural marketing chain or supply-demand chain</b></p> <ul style="list-style-type: none"> <li>• Identify and describe a marketing chain/supply-demand chain</li> <li>• Factors that hamper the marketing chain of agricultural products</li> <li>• Indicate ways to streamline and improve the agribusiness chain</li> <li>• Briefly describe the role of legislation in the effective marketing of agricultural products</li> </ul>
<b>Agricultural entrepreneurship and business planning</b>	<ul style="list-style-type: none"> <li>• Define an entrepreneur and entrepreneurship</li> <li>• Describe the important aspects of the entrepreneur and entrepreneurship</li> <li>• Describe the entrepreneurial success factors or personal characteristics</li> <li>• Identify the main distinct phases of the entrepreneurial process</li> <li>• Define and outline a business plan</li> <li>• Identify and indicate the reasons for drawing up a business plan in the agricultural sector</li> <li>• Outline the standard format and layout (components) of an agricultural business plan</li> <li>• Indicate the problems encountered when drawing up an agribusiness plan</li> <li>• Identify electronic resources used as a tool for drawing up an agribusiness plan</li> </ul> <p><b>Agribusiness plan</b></p> <ul style="list-style-type: none"> <li>□ Describe a basic SWOT analysis</li> </ul>

## QUESTION 1

### Marketing functions

1.1 The pictures below illustrate the functions of marketing



1.1.1 Identify the marketing functions illustrated in B and C. (2)

1.1.2 State TWO guidelines for the marketing function in C. (2)

1.1.3 Name TWO advantages of the marketing function in A. (2)

1.1.4 Suggest TWO aspects to consider when choosing D. (2)

1.2 Give a marketing function that matches EACH of the following statements:

1.2.1 Products are placed in boxes. (1)

- |   |     |      |
|---|-----|------|
| 1.2.2 Products are kept in cool place giving them a longer shelf-life | (1) |      |
| 1.2.3 Changing a product from its raw form                            | (1) |      |
| 1.2.4 Produce is moved from the farm to consumers.                    | (1) | (12) |

## QUESTION 2

2.1 A farmer needs to understand how the market works and how best to place the product.



- |  |     |
|--|-----|
| 2.1.1 Define the concept of <i>marketing</i> .   | (2) |
| 2.1.2 From the items shown in the image above, identify the elements that are part of the marketing mix model. | (3) |
| 2.1.3 Identify the synonym for “ <b>consumers</b> ” in the picture above.                                      | (1) |
| 2.1.4 Indicate for EACH of the descriptions below, (a) to (c), whether it refers to marketing or selling.      |     |
| (a) Market survey conducted on 300 customers to determine their needs  | (1) |
| (b) Focus on acquiring money to buy a container to sell the produce in that season.                            | (1) |
| (c) Focus on the number of bags of potatoes sold at a time   | (1) |

- (d) Requires long term plan
- (e) Sales volume orientated

(1)  
(1)  
**(11)**

### QUESTION 3

### QUESTION 4

4.1 Various options are provided as possible answers to the following questions. Select the appropriate answer and write only the corresponding letter (A–D) beside each question number (1.1 to 1.5) in your answer book.

4.1.1 One of the following is not a characteristic of the term selling?

- A A long- term plan
- B Personal communication of information
- C Exchange of goods for cash
- D Convincing people to buy a product.

4.1.2 An advantage of processing raw agricultural produce is:

- A Reduce oversupply and wastage
- B A decrease in job opportunities
- C A decrease in the value of the product
- D. A shorter shelf life

4.1.3 Division of market into smaller groups based on income, geography, demography, behaviour

- A Mass marketing

- B Niche marketing
  - C Multi-segment marketing
  - D Green marketing
- 4.1.4 ... occurs at the point where the market demand and supply curves meet.
- A Shortage
  - B Market development
  - C Surplus
  - D Market equilibrium

4.1.5 One of the following factors influences the supply of a product.

- A Increases in the number of consumers
- B Taste and preference of the consumers in the short term
- C Government subsidies and taxation policies
- D The range of the product.

(10)

### **QUESTION 5**

5.1 The diagram below shows the demand for maize meal at different prices within a period of two months



- 5.1.1 Identify the marketing concept illustrated by demand **A** and **B** above.
- 5.1.2 Give a reason for the answer to QUESTION 2.

(2)

(2)



5.1.3 Explain the reason why consumers responded in such a way to price change. (2)

5.1.4 Suggest TWO other products that could have caused consumers to respond in the same way as in Q 5.1.1. (2)

5.1.5 Suggest ONE product that would have caused a different response to Q 2.1.1. (1) (1)

### **QUESTION 6**

6.1 The table below represents the quantities of fruit sold at different prices.

PRICE (R)	QUANTITIES OF FRUIT (POCKETS)
20	3 500
25	3 000
30	2 500
35	2 000
40	1 500
45	1 000

6.1.1 Use the data in the table above to draw a line graph comparing the quantities and the prices of the pockets of fruit. (6)

6.1.2 Deduce the relationship between the price and the quantity of fruit demanded. (2)

(8)

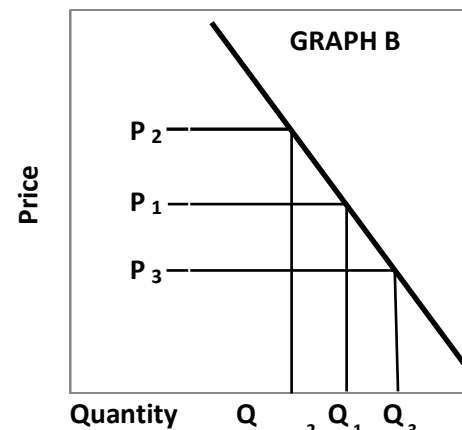
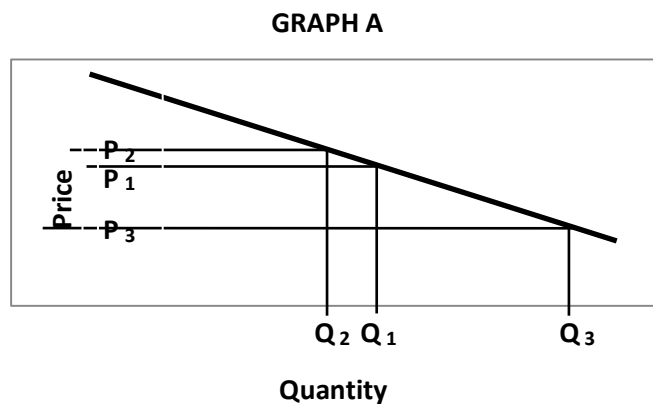
### **QUESTION 7**

7.1 Change the underlined words in each of the following statements to make them TRUE . Write only the answer next to the question 7.1.1-.7-1.6 in the ANSWER BOOK.

- 7.1.1 Controlled marketing is system where two or more independent organisations work together to meet their common economic ,social and cultural needs.
- 7.1.2 Hedging is a form of marketing where goods are exchanged for other goods or services.
- 7.1.3 Selling is a customer orientated.
- 7.1.4 Value-adding is the alteration of the raw product into a form that is easier for the consumer.
- 7.1.5 Packaging involves covering and labelling the product so that it appeals to the marketer.

## QUESTION 8

8.1 The graphs below show the change in the demand for products in relation to the change in price.



- 8.1.1 Identify the graph (A or B) that represents EACH of the following:
- (a) Price inelasticity of supply (1)
  - (b) Price elasticity of demand (1)
- 8.1.2 Give a reason for your answers to QUESTION 8.11(a) and (b). (2)
- 8.1.3** State THREE other factors that may cause decrease in demand of . (3)
- 8.2 Define the following concepts
- 8.2.1 Price elasticity of supply (2)
  - 8.2.2 Controlled marketing (2)
  - 8.2.3 Pool system (2)
  - 8.2.4 Entrepreneurship (2)
  - 8.2.5 Hedging (2)

## QUESTION 9

9.3 The marketing channels below are related to free marketing system.

9.3.1 Give one marketing channel for EACH of the statements from the list below: Write only the channel next to the question numbers 9.3.1-9.3.4

Internet marketing; stock sales; fresh produce market; farm gate marketing; contract marketing.
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- (a) A farmer sells spinach direct from the farm. (1)
- (b) Goat, sheep and cattle are sold to the highest bidder. (1)
- (c) Products are electronically advertised and sold (1)
- (d) Mangoes and apples are delivered to markets immediately (1)

9.3.2 Name TWO disadvantages of a free marketing system (2)

9.4 Two groups of learners used different strategies to promote and market their produce from the school garden.

GROUP 1	GROUP 2
Sold vegetables to the local supermarket	Sold vegetables from door to door at their own price
Vegetables from each individual in the group were combined into one stockpile for marketing	Each individual in the group was responsible for selling their own produce

9.4.1 Identify the marketing system used by GROUP 2 (1)

9.4.2. Refer to the table above and justify with TWO reasons why the marketing system identified in QUESTION 9.4.1 was chosen. (2)

9.5 Avocado pear farmers grouped themselves to produce and sell their produce together.

9.5.1 Identify the agricultural marketing system used by the farmers (1)

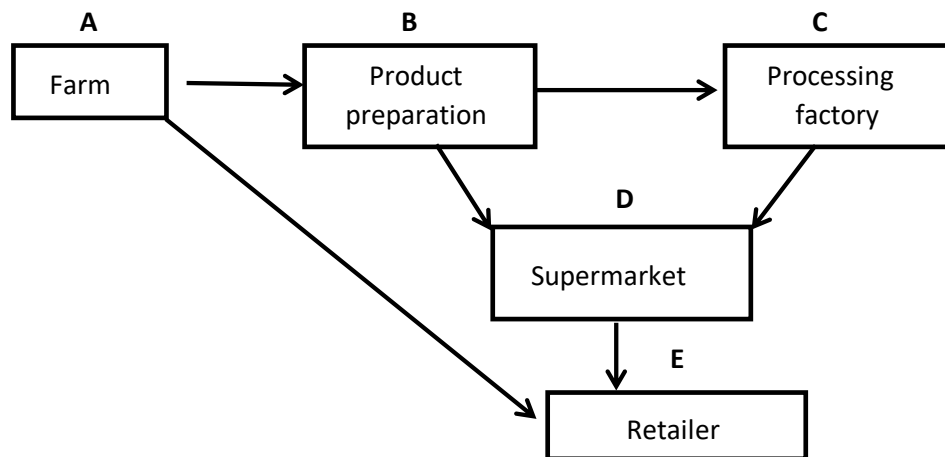
9.5.2 Indicate the role of the marketing system in QUESTION 9.5.1 (1)

9.5.3 Name TWO benefits of the marketing system in QUESTION 9.5.2 (2)

9.5.4 State TWO factors that may hamper the marketing of avocado pears (2)

## QUESTION 10

10.1 The flow chart represents a marketing chain



10.1.1 Identify the marketing chain illustrated above (1)

10.1.2 Name the factor that may hamper the marketing at stage E if fewer products are sold (1)

10.1.3 Indicate TWO ways to improve the agribusiness chain between stage A and stage E. (2)

## QUESTION 11

11.1 A business plan is a plan of action that an entrepreneur should have for a business.

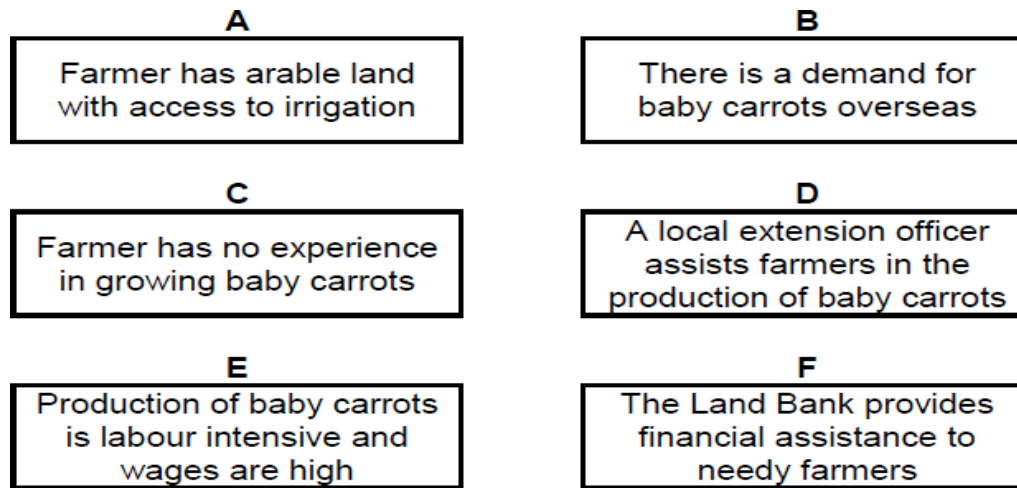
11.1.1 Give TWO reasons for drawing up a business plan. (2)

11.1.2 List THREE items that should be included in the format of a good business plan.(3)

11.1.3 State TWO problems that may be encountered when drawing up a business plan. (2)

1

11.2 The schematic representation below shows the aspects of a SWOT analysis done by an emerging farmer.



11.2.1 Link statement A, B, C and E in the schematic representation with the elements of a SWOT analysis. (4)

11.2.2 Explain how the farmer may use the strengths and opportunities in the schematic representation above to improve the farming enterprise.(2)

## QUESTION 12

An entrepreneur is a person who identifies an opportunity for a business, does research on what will be needed and combines good ideas with the forces of production to produce and make profit.

12.1.1 In the scenario above, identify THREE phases of the entrepreneurial process. (3)

12.1.2 Name THREE personal characteristics of a successful entrepreneur. (3)

### QUESTION 13



Identify the level of market segmentation from the image above:

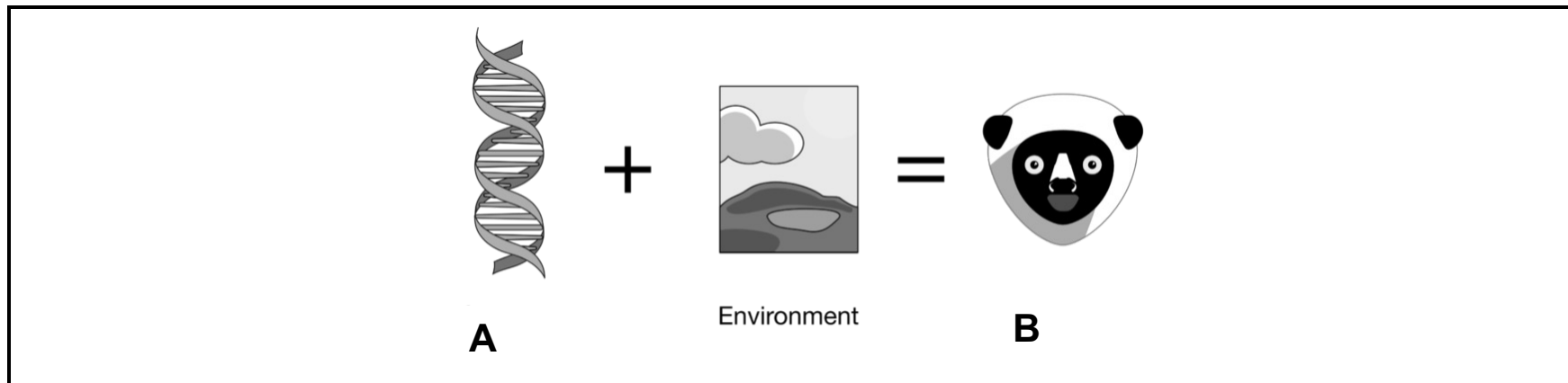
- 13.1.1 Brand offers a diverse menu to cater to various tastes and preferences. (1)
- 13.1.2 Brand specialize in offering products designed exclusively for left-handed individuals. (1)
- 13.1.3 Brand employs colourful billboards along busy roads. (1)



## TOPIC 6 BASIC AGRICULTURAL GENETICS

MAIN TOPIC	SUGGESTED CONTENT
<b>Basic agricultural genetics</b>  <b>Monohybrid inheritance</b>  <b>Dihybrid inheritance</b>	<b>Genetic concepts</b> <ul style="list-style-type: none"> <li>Define basic genetic terminology, like genetics/heredity, genes, chromosomes and alleles (homozygous and heterozygous)</li> <li>Distinguish between genotype and phenotype, dominant and recessive genes</li> <li>Indicate a monohybrid inheritance/crosses (Mendel's first law: law of segregation)</li> <li>Indicate a dihybrid inheritance/dihybrid cross (Mendel's second law: law of independent assortment)</li> <li>Use various methods, such as a Punnett square, genetic diagrams and schematic representations to illustrate the crosses</li> <li>Describe Mendel's laws of segregation and independent recombination of characteristics □ Distinguish between qualitative and quantitative characteristics</li> </ul>
<b>The pattern of inheritance</b>	<ul style="list-style-type: none"> <li>Identify and describe the pattern of inheritance that leads to different phenotypes: incomplete dominance, co-dominance, multiple alleles, polygenic inheritance and epistasis</li> <li>Define the concept of prepotency and atavism with relevant examples</li> <li>Describe the sex chromosomes and sex-linked characteristics (examples)</li> </ul>
<b>Variation and mutation</b>	<ul style="list-style-type: none"> <li>Define genetic terminology, like variation, mutation and selection</li> <li>Identify and describe the importance of variation and selection</li> <li>Discuss the external (environmental) and internal (genetic) causes of variation</li> <li>Identify the types of mutagenic agents and their effects (changes in chromosome structures)</li> </ul>
<b>Selection</b>	<ul style="list-style-type: none"> <li>Indicate the general principles of selection, like biometrics, heritability and estimated breeding values (EBVs), and compare natural and artificial selection</li> <li>Indicate the selection methods used by plants and animal breeders (mass, pedigree, family and progeny selection) and breeding values</li> <li>Identify and describe inbreeding, line-breeding with relevant examples, cross breeding, upgrading, species crossing, out-crossing and the advantages and disadvantages of these different breeding systems</li> </ul>

### QUESTION 1



1.1.1 Give a correct terms represented by letters **A** and **B** in the illustration above. (1)

1.1.2 Define homologous chromosome (1)

1.1.3 Explain Mendel's Law of Independent Assortment. - (2)

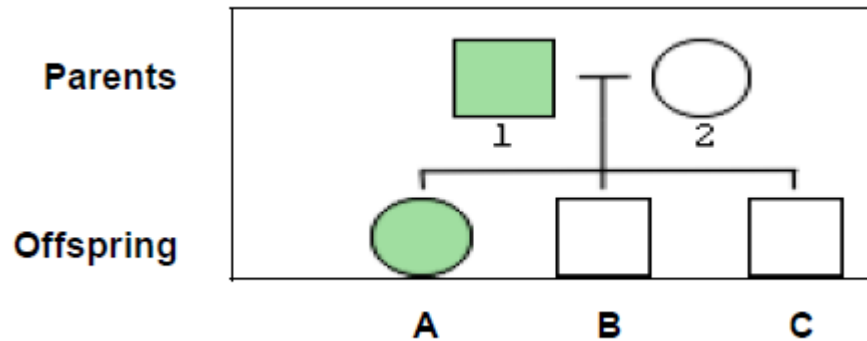
**1.2** In pigs, red hair colour (R) is dominant over white colour (r). A white sow was mated with a red boar and all piglets in the  $F_1$  were red.

1.2.1 Use the Punnett square method to determine the genotype of the  $F_1$ -generation. (4)

1.2.2 Calculate the percentage of homozygous red piglets. (2)

## QUESTION 2

2.1 The schematic representation below represents the crossing between two parent animals with different traits. The one trait is represented by colour (dark colour or white) and the other by the shape of the diagram (square or circle)



- 2.1.1 Indicate the percentage of genetic material that each of the offspring receives from each of the parents. (1)
- 2.1.2 Tabulate the traits (shape and colour) that each of the offspring, indicated by A, B and C in the schematic representation, received from the parent marked (2).
- 2.1.3 Deduce from the schematic representation and data supplied above the TWO possible traits (shape or colour) that are dominant when the offspring is compared to the parents. (2)

### QUESTION 3

3.1 In pea plants, spherical seeds(S) are dominant over desired seeds(s).Two heterozygous plants for seed shape were crossed, as shown in the Punnet square below.

GAMETES	S	s
S	SS	Ss
s	Ss	ss

3.1.1 Indicate the fraction of the offspring that will have dented seeds ( 1)

3.1.2 Calculate the percentage of heterozygous spherical seeds (2)

3.1.3 Determine the phenotypic ratio of the F1 generation(1)

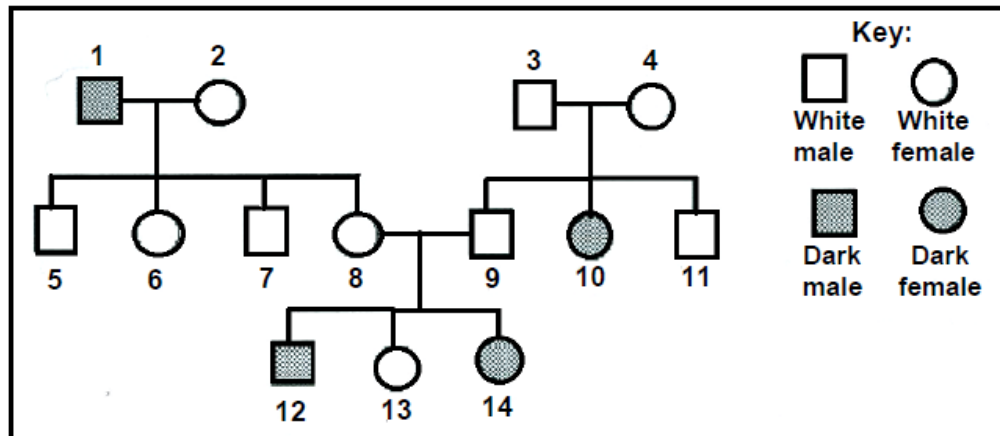
3.1.4 Give the number of offspring that will look similar to the parents (1)

#### QUESTION 4

- 4.1 Pure-bred Shorthorn cattle may be either red or white. The red colour is the dominant characteristic but when they are crossed, their hybrid offspring are neither red nor white. They are roan, which is a combination of red and white and represents incomplete dominance.
- 4.1.1 R is used to represent the genotype for red colour. Indicate the letter that you would use for the white colour. Motivate your answer. (2)
- 4.1.2 Determine the genotype for roan cattle. Explain your answer. (2)
- 4.1.3 Draw a schematic representation of the crossing between a homozygotic red Shorthorn bull and a white Shorthorn cow to predict the possible phenotypes and genotypes of the offspring. (6)

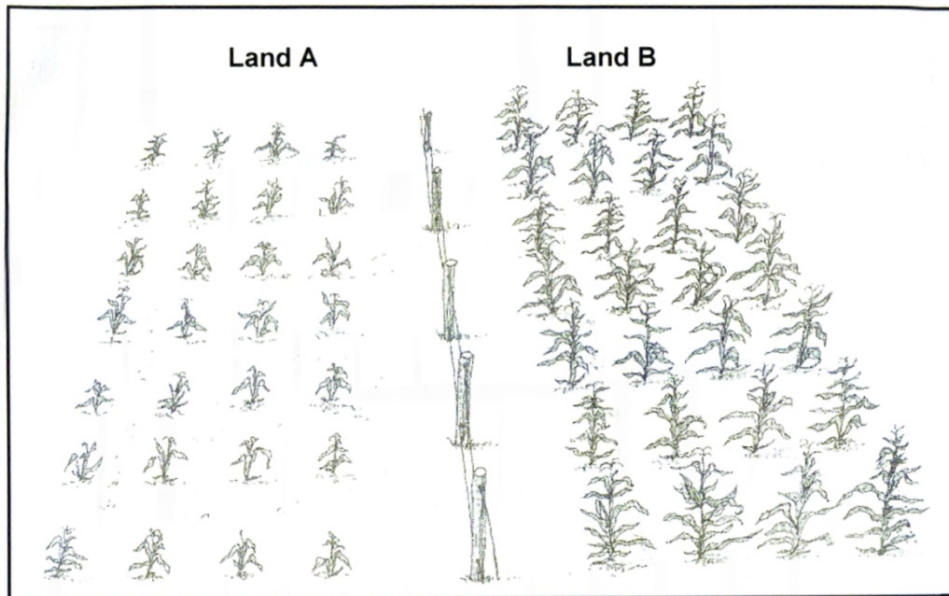
## QUESTION 5

5.1 The illustrations below show the crossing of different flowers.



- 5.1.2 Indicate the phenotype of individuals 5 and 12. (1)
- 5.1.3. Predict which individual (3 or 10) would be: (2)
- Homozygous
  - Heterozygous
- 5.1.4 Determine, as a percentage, the probability of having a female offspring by referring to the offspring of the first two sets of parents in the schematic representation above. (2)

## Activity 6



The crops in Field A and Field B both come from the same seed with the same genes for height and were planted at the same time in different areas.

- 6.1.1 Suggest THREE external factors that might have greatly contributed to the difference in the heights of the plants in the two fields. (3)
- 6.1.2 Identify ONE dependent variable that the scientists were trying to investigate on these fields.

6.2

Variation is important to farmers because it is the foundation of natural breeding programmes. A farmer would prefer to have animals that are ideally suited to the specific agricultural production environment. Sheep kept in the harsh semi-desert area of the Karoo have been selected by nature through droughts and other harsh environmental factors. Only the more adapted animals and their offspring manage to survive.

6.2.1 Identify the process of selection referred to in the passage above. (1)

6.2.2 Name the TWO most important uses of variation in breeding. (2)

6.2.3 Describe how the heritability of characteristics will influence the success of a breeding programme. (2)

### Question 7

7.1 Name FOUR selection methods used by animal breeders.. (4)

7.2

Traditionally people used a selection and breeding method whereby the best bulls for growth, health and fertility were shared between family and friends. They also cared for their animals by utilising the best available pastures and keeping them away from wet and muddy areas.

7.2.1 Define the concept *selection*. (2)

7.2.2 Determine the method of selection mentioned in the passage above. (1).

7.2.3 Identify THREE animal production characteristics in the passage that were used for selection by these people. (3)

7.2.4 Indicate how the following aspects were used by the people in the passage above to improve the phenotype of the animals:

(a) Genetic variation

(b) Environmental variation (2)



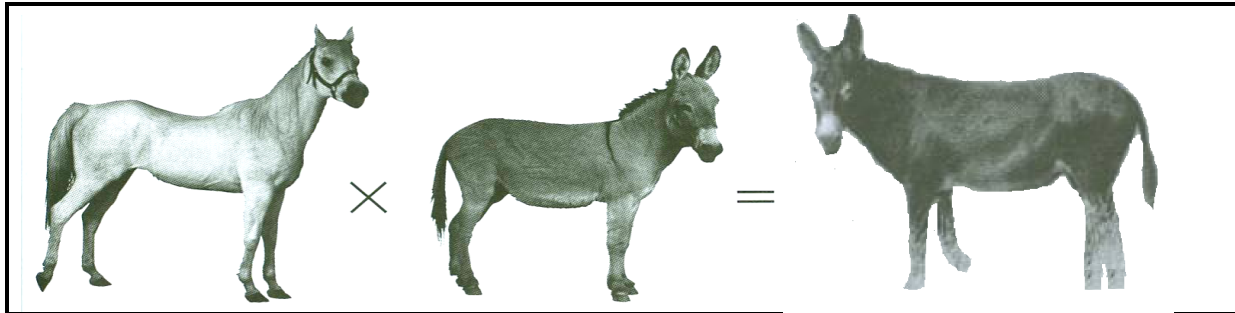
## Question 8

8.1 The crossings A, B and C below represent different breeding systems applied in cattle farming.

<b>A</b>	<b>B</b>	<b>C</b>	<b>D.</b>
Commercial mixed-breed cow	Sussex bull	Sussex bull	Afrikaner bull
<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
Holstein stud bull	Sussex cow (bull's daughter)	Sussex cow(not-related)	Shorthorn cows

- 8.1.1 Identify the breeding systems represented by **A, B, C** and **D**. (4)
- 8.1.2 Indicate the breeding system (**A, B** or **C**) that promotes homozygosis. (1)
- 8.1.3 Give a reason for your answer in Question 8.1.2. (1)
- 8.1.4 Indicate the breeding system (**A, B** or **C**) that promotes heterosis. (1)
- 8.1.5 Give a reason for your answer in Question 8.1.4 (1)
- 8.1.6 Deduce the widest form of heterosis/heterozygosity (1)
- 8.1.7 State TWO disadvantages of the breeding system represented by crossing **B**. (2)
- 8.1.8 Suggest the best method a farmer can use to change the enterprise from a commercial meat production with Brahman to a Bonsmara stud within a period of 20 years. (1)

9.1 The diagram below shows a type of breeding system used by some livestock farmers.



9.1.1 Identify the type of breeding system illustrated above.

9.1.2 Name the type of animal produced by the breeding system in QUESTION 12.1. (1)

9.1.3 State TWO uses of the animal produced by this system of breeding in farming. (2)

10.1 Assume that four pairs of genes control the height of pepper plants. The base height of a recessive plant (aabbccdd) is 40 cm. Each additive allele contributes 4 cm to the base height.

10.1.1 Calculate the height of a plant with an AaBbCcDD genotype. (2)

10.1.2 Determine EACH of the following:

- (a) FOUR genotypes of a plant with a height of 68 cm (4)
- (b) Genotype of the tallest plant (1)
- (c) Genotype of the shortest plant (1)

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