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Province of the
EASTERN CAPE
EDUCATION

AGRICULTURAL SCIENCES

AUTUMN CLASSES

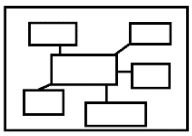
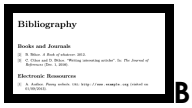
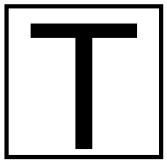
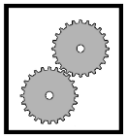
GRADE 12

TERM 1

ANIMAL NUTRITION

TEACHER AND LEARNER CONTENT MANUAL

ICON DESCRIPTION

 MIND MAP	 EXAMINATION GUIDELINE	 CONTENTS	 ACTIVITIES
 BIBLIOGRAPHY	 TERMINOLOGY	 WORKED EXAMPLES	 STEPS

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TOPIC 1: ANIMAL NUTRITION

UNIT 1: THE STRUCTURE OF ALIMENTARY CANAL
EXAMINATION GUIDELINE AND OUTCOME
● Compare the external structure of the alimentary canal of a ruminant (cow and sheep) and a non-ruminant (fowl and pig) ● Functions and adaptations of various structures of the alimentary canal ● Description of the internal structure of the rumen, reticulum, omasum, abomasum and small intestines

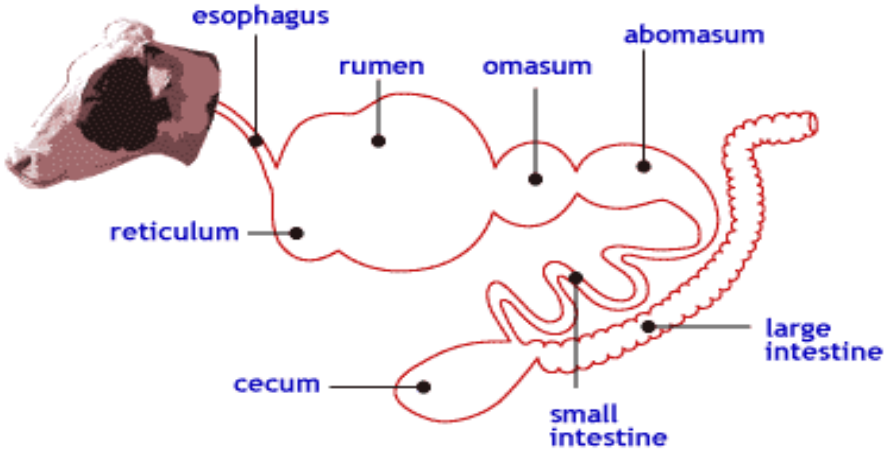
IMPORTANT TERMS AND DEFITIONS	T
Animals that have complex stomach	Ruminants
Animals that have single stomach	Non-ruminants
The continuous tube running from the mouth to the anus through which food is ingested, digested, absorbed, and waste expelled.	Alimentary canal
A monogastric stomach is a single-chambered stomach found in non-ruminant animals	Monogastric stomach
A complex stomach refers to the multi-chambered stomach of ruminant animals, comprising the rumen, reticulum, omasum, and abomasum.	Complex stomach
Largest compartment of the ruminant stomach.	Rumen
A muscular tube that carries food and liquid from your throat/pharynx to your stomach.	Oesophagus/Gullet

1 ALIMENTARY CANAL OF RUMINANT AND NON-RUMINANT

The alimentary canal is the passage along which food passes through the body. The external structure of the alimentary canal of ruminants and non-ruminants is different. Ruminants such as cattle and sheep have complex stomach (four compartment). Non-ruminants (monogastric animals) such as fowl and pig have single stomach.

1.1 Ruminants

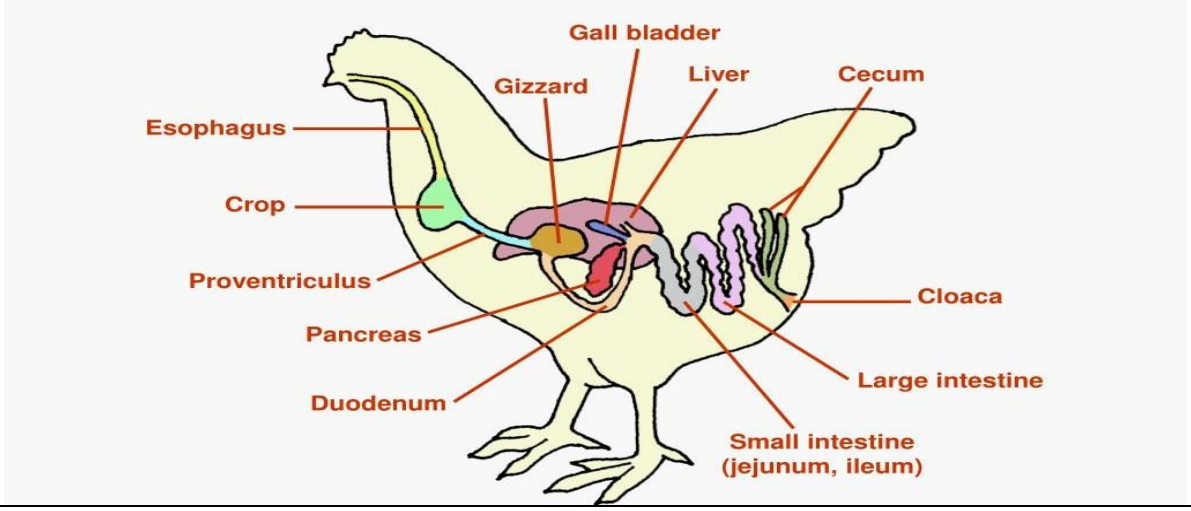
Cows and sheep are examples of ruminants. Alimentary canal of ruminant is made-up of organs illustrated on the diagram below , including the mouth. Note that complex stomach is made up of rumen, reticulum, omasum and abomasum.



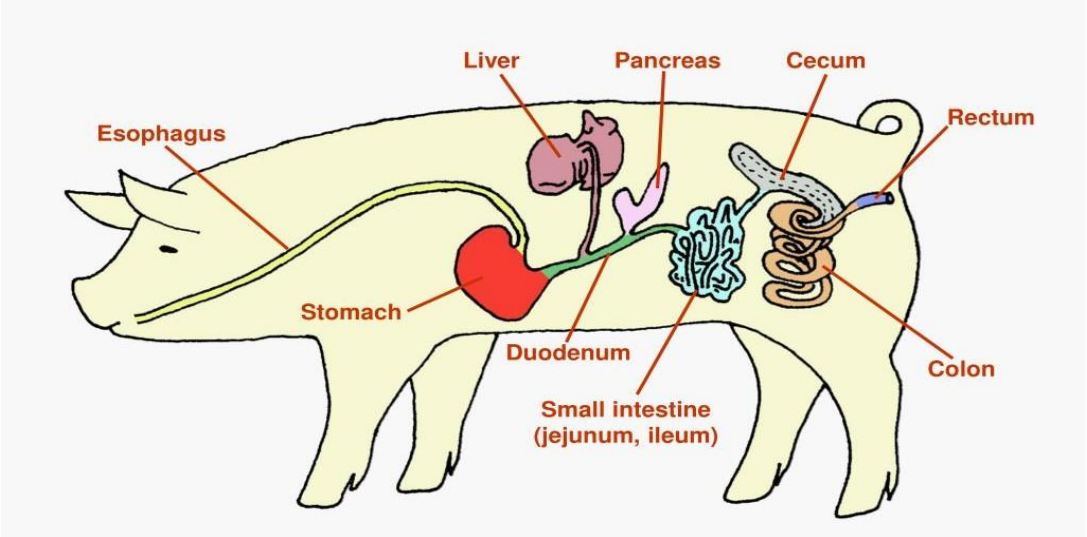
1.2 Non-ruminants

Animals such as fowl and pig are examples of non-ruminant or monogastric animals. They have single or simple stomach. The oesophagus and stomach of fowl are modified to process the food that fowls consume. Stomach of fowl is divided into two compartments called the proventriculus and the gizzard. The pig is a typical non-ruminant. It has a single stomach.

Digestive system of fowl



Digestive system of pig



UNIT 2: DIGESTION IN RUMINANTS AND NON-RUMINANTS

EXAMINATION GUIDELINE AND OUTCOME

Digestion in non-ruminants

- A brief explanation of the intake of feed
- The mechanical and/or chemical (enzymes) digestion processes in the mouth, stomach, small intestine and the large intestine
- Functions of the salivary glands, the liver, pancreas and intestinal glands (accessory glands)

Digestion in ruminants

- Definitions of rumination, regurgitation and peristalsis
- Explanation of the intake of food and the chewing of the cud (swallowing and re-swallowing)
- The differences in size and functionality of the four stomach compartments of a mature

ruminant compared to a young ruminant

Digestion in the rumen

- Describe rumen microbes as single-celled organisms found in the reticulorumen
- Briefly classify the different types of rumen microbes
- Specific functions of different bacteria (cellulytic, proteolytic, amylolytic)
- Describe the most important requirements for normal functioning of rumen microbes/microorganisms
- Name the functions of the rumen microbes
- Explain the direct absorption of food in the rumen and small intestine directly by osmosis, diffusion and active transport into the blood stream

IMPORTANT TERMS AND DEFITIONS	T
The process of breaking down food into smaller components that the body can absorb	Digestion
The physical breakdown of food into smaller pieces without altering its chemical structure (chewing)	Mechanical digestion
The enzymatic breakdown of complex food molecules into simpler, absorbable forms	Chemical digestion
Organs that aid in digestion by secreting enzymes and other substances into the digestive tract.	Accessory glands
Microscopic organisms, such as bacteria, viruses, and fungi.	Micro-organism (microbes)
The backward flow of undigested food from the stomach to the mouth of ruminants for rechewing.	Regurgitation/R
A metabolic process where microbes convert carbohydrates into alcohols or acids anaerobically.	Fermentation
Involuntary, rhythmic contractions of smooth muscles in the digestive tract that propel food forward from the esophagus to the intestines.	Peristalsis
The reverse of peristalsis; it involves the backward movement of contents in the digestive tract	Retro peristalsis

2.1 DIGESTION IN RUMINANTS AND NON-RUMINANTS

This table summarizes how ruminants and non-ruminants process food differently but rely on similar digestive structures and functions to break down and absorb nutrients. Highlight is on digestion process in ruminants and non-ruminants, covering feed intake, mechanical digestion, chemical digestion, and the functions of accessory glands:

Feature	Ruminant Digestion	Non-Ruminant Digestion
Feed Intake	Ruminants primarily consume fibrous plant material (e.g., grasses). They have a specialized digestive system to process high-fiber diets.	Non-ruminants consume a more varied diet, including grains, fruits, and animal products, with a relatively simpler digestive system.
Mechanical Digestion	Involves chewing and the rumination process (cud chewing). The food is initially swallowed into the rumen,	Mechanical digestion occurs in the mouth, where food is broken down by chewing. In some species, there may

Feature	Ruminant Digestion	Non-Ruminant Digestion
	then regurgitated to be chewed again.	be additional processing in the stomach.
Chemical Digestion	Chemical digestion begins in the rumen, where microbial fermentation breaks down complex fibers. Enzymes and acids in the abomasum further digest food.	Chemical digestion begins in the stomach with the secretion of hydrochloric acid (HCl) and digestive enzymes like pepsin, breaking down proteins and food particles.
Functions of Accessory Glands	- Salivary glands: Produce saliva with enzymes like amylase to aid in fermentation and lubrication. - Liver: Secretes bile for fat digestion in the small intestine. - Pancreas: Secretes digestive enzymes for carbohydrate, protein, and fat digestion.	- Salivary glands: Produce saliva with amylase, which starts starch digestion. - Liver: Produces bile for fat emulsification in the small intestine. - Pancreas: Secretes digestive enzymes for protein, carbohydrate, and fat digestion.

2.2 DIGESTION IN RUMINANTS

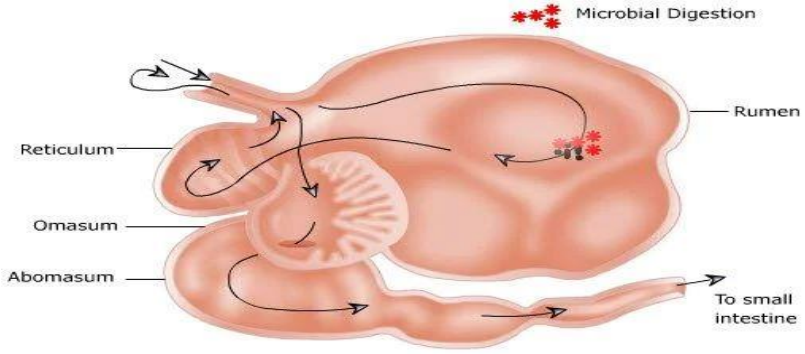
Regurgitation is part of the digestive process for ruminants known as rumination.

Ruminants regurgitate coarse feed back to the mouth to rechew and break it down into smaller pieces and improve digestion.

Ruminants regurgitate food from their first and second stomach chambers, called the rumen and reticulum, back into their mouths.

It is stimulated by the presence of roughage in the upper part of the reticulo-rumen. Rumination increases salivary flow, which helps maintain a stable pH environment in the rumen.

2.3 PROCESS OF RUMINATION



Ingestion: Food is initially ingested and enters the rumen, where it is mixed with saliva and undergoes fermentation by microbes.

Fermentation: The fibrous food is fermented by microbes in the rumen to break it down into simpler compounds, producing gases like methane.

Regurgitation: The partially digested food (called "cud") moves from the rumen to the reticulum. When it's time to re-chew, the cud is sent back to the mouth via the esophagus

Please turn

for further grinding.
Re-chewing: The cow chews the cud thoroughly, which breaks it down further, allowing the microbes to act more effectively during fermentation.
Re-swallowing: After re-chewing, the cud is swallowed again, passing through the reticulum and into the omasum for more water absorption and nutrient breakdown before entering the abomasum (the true stomach).

2.4 YOUNG RUMINANT VS MATURE RUMINANT

As the young ruminant transitions to eating solid feed, the rumen and reticulum develop, and microbial fermentation becomes the primary digestive process.

2.4.1 Summary of the differences between a young ruminant and mature ruminant based on the stomach compartment.

Compartment	Young Ruminant	Mature Ruminant
Rumen	Small, non-functional, stores food	Large, responsible for fermentation
Reticulum	Small, minimal role	Medium, aids in mixing and regurgitation
Omasum	Very small, not functional	Medium, absorbs water and nutrients
Abomasum	Large, primarily digests milk	Smaller, digests proteins and enzymes

2.5 RUMEN MICROBES

The reticulo-rumen is where most of the microbial fermentation occurs, allowing ruminants to digest fibrous plant material like grasses and forages that would otherwise be indigestible. The microorganisms break down complex carbohydrates, such as cellulose and hemicellulose, into volatile fatty acids (VFAs) like acetic acid, propionic acid, and butyric acid, which the ruminant absorbs and uses for energy.

2.5.1 Summary of Functions of Rumen Microbes

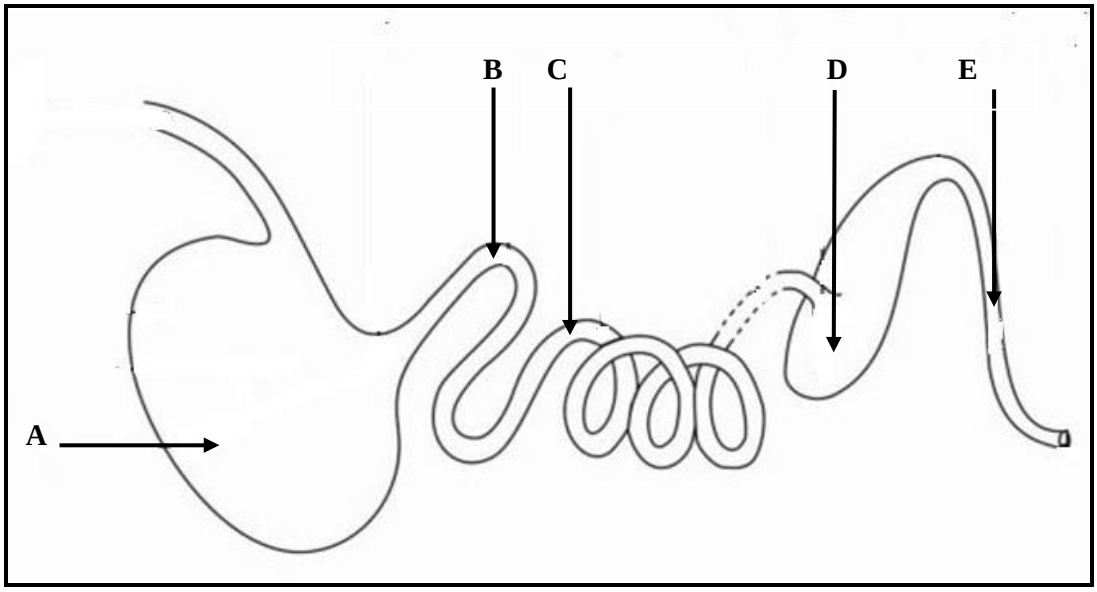
Microbe Type	Role in Fermentation Process	Key Products Produced
Bacteria	Break down cellulose, starch, and proteins	Volatile fatty acids (VFAs), methane
Protozoa	Regulate bacterial population, digest plant material	Digestive enzymes, control microbial balance
Fungi	Break down lignin and plant cell walls	Increased surface area for bacterial digestion

2.5.2 End products of MICROBIAL digestion

Bacterial Group	Key Role in Fermentation	Key Products Produced
Cellulolytic Bacteria	Break down cellulose into simpler sugars	Acetate, butyrate, hydrogen
Amylolytic Bacteria	Break down starches into glucose and smaller sugars	Propionate, acetate, butyrate
Proteolytic Bacteria	Break down proteins into amino acids and peptides	Amino acids, VFAs, ammonia

1.1 Activities

1. The diagram below represents the alimentary canal of a farm animal.



1.1 Name and classify the farm animal represented by the alimentary canal in the diagram above. (1)

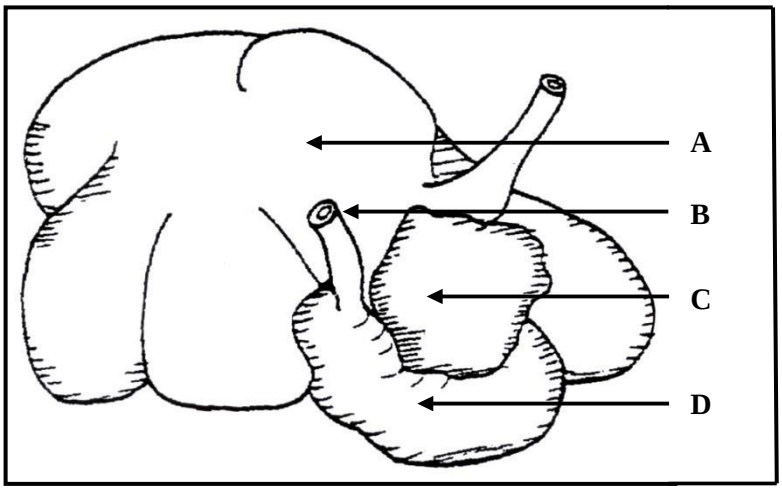
1.2 Indicate the importance of parts A and C in the digestion of feed of the farm animal identified in QUESTION 1.1 (2)

1.3 Name the substances that are secreted into part B from the liver and pancreatic glands respectively. (2)

1.3 Explain mechanical digestion as it occurs in the alimentary canal of the farm animal identified above. (2)

[7]

2. The diagram below illustrates the alimentary canal of a farm animal.



2.1 Write down the letter (A–D) of the part where cellulose digestion occurs. (1)

2.2 Name the cellulose-digesting enzyme secreted by the organisms in part A. (1)

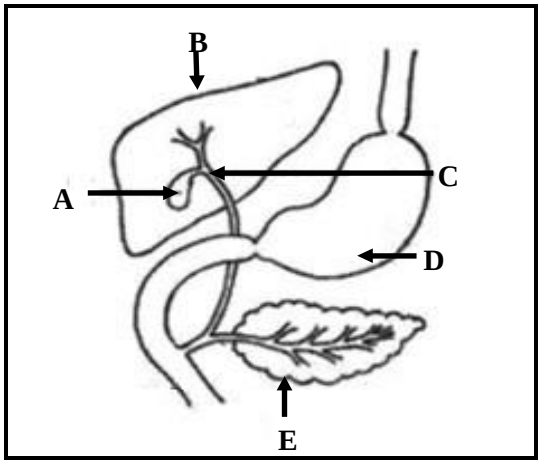
2.3 State TWO requirements of the organisms found in part A. (2)

2.4 Indicate the type of digestion that occurs in part D. (1)

2.5 Give a reason for your answer to QUESTION 2.4. (1)

[7]

3. The diagram below shows a section of the alimentary canal of a farm animal.



3.1 Indicate whether the farm animal in the diagram above is a ruminant or a non-ruminant. (1)

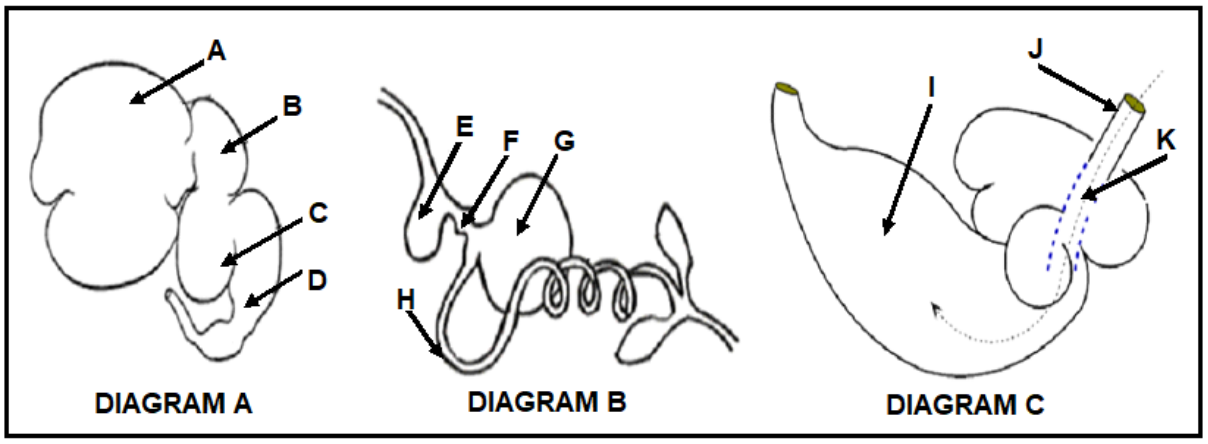
3.2 Give a reason for the answer in QUESTION 3.1 (1)

3.3 State TWO functions of the digestive juice in A. (2)

3.4 Name a fat-digesting enzyme in the digestive juice secreted by E. (1)

[5]

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



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

4.2 Identify parts E and J from the diagrams above. (2)

4.3 Identify the alimentary canal of a young ruminant animal from those shown above. (1)

4.4 Justify your answer to QUESTION 4.3 (1)

4.5 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) Enzymatic digestion in DIAGRAM B (1)

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

[9]

UNIT 3: TYPES OF FEED	
EXAMINATION GUIDELINE AND OUTCOME	
● Illustrate the basic classification of animal feeds ● Define roughages and concentrates	
● Describe the different types of roughages and concentrates	
● Make a schematic representation of different types of animal feeds	
● Importance of roughage and concentrates as feeds for different types of animals (ruminants and non-ruminants)	
IMPORTANT TERMS AND DEFITIONS	T
Roughages are feeds that are high in fiber and low in total digestible nutrients.	Roughages
Concentrates are feeds that are high in energy and low in fiber.	Concentrates

3.1 TYPES OF FEEDS

In animal nutrition, feed is typically categorized into two main types: roughage and concentrate. Each serves a distinct purpose in the diet of livestock, providing the animals with necessary nutrients in different forms.

3.1.1 Roughage (also known as Forage)

Roughage refers to fibrous plant material that is high in cellulose and provides bulk in the animal's diet. It is often the primary source of fiber, which aids in digestion and helps maintain gut health in herbivores. Roughage is typically low in energy but rich in fiber and can include materials like: Grass (fresh or dried), Hay (dried grass or legumes), Silage (fermented green fodder, like corn silage), Straw (leftover stems after grain harvesting) and Legumes (clover, alfalfa, etc.)

3.1.2 Benefits of Roughage

Promotes digestive health: The high fibre content encourages chewing and saliva production, which aids in digestion.
Provides energy over time: While low in calories, roughage provides slow-digesting energy.
Maintains gut motility: The fibre in roughage helps regulate the movement of food through the intestines, preventing digestive disorders like constipation.
Essential for ruminants: Animals like cattle, sheep, and goats rely on roughage to maintain their rumen health.

3.1.3 Concentrates

Concentrates are feeds that are rich in energy, protein, and other nutrients, but low in fibre. These are usually more digestible and provide higher levels of essential nutrients in a smaller amount of feed. Concentrates are commonly used to complement roughage-based diets, particularly in animals that require high energy for growth, milk production, or high-intensity labour.
Concentrates include: Grains (maize, wheat, barley, oats), Oilseeds (soybeans, sunflower seeds), By-products (distillers grains, bran, etc.), Concentrated protein sources (like soybean meal, fish meal)

Please turn

3.1.4 Benefits of Concentrates:

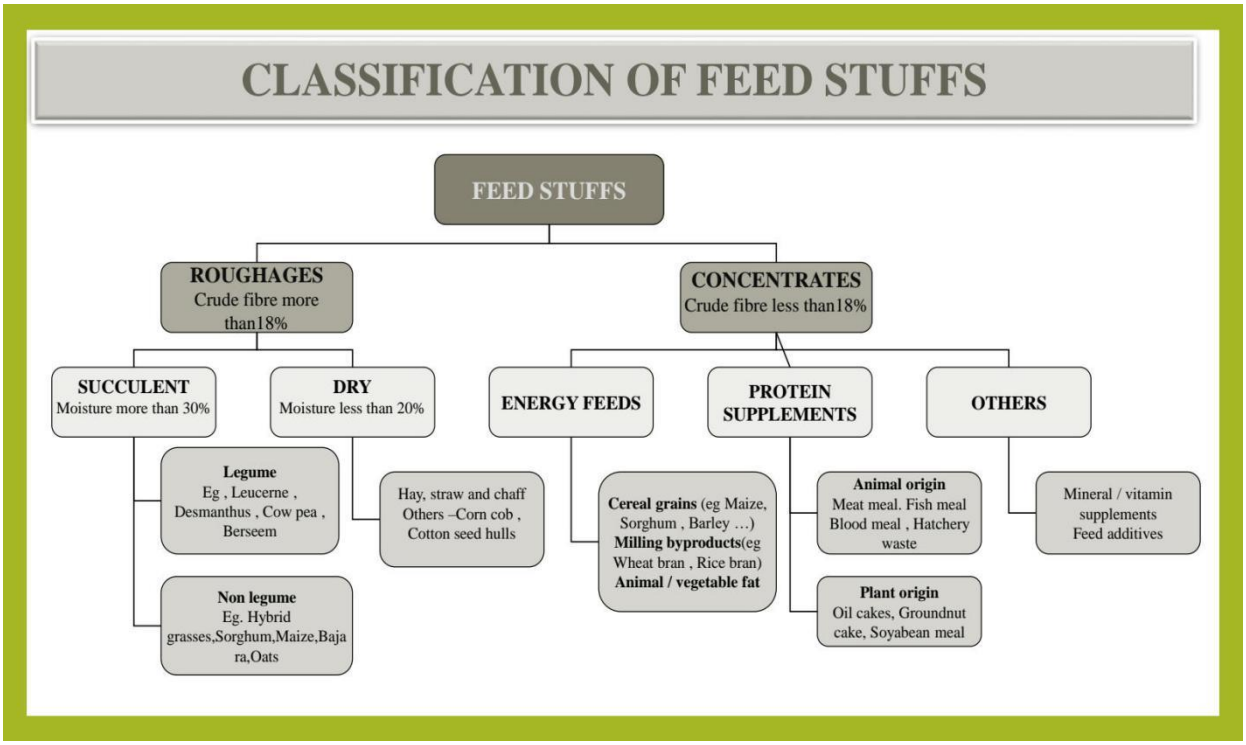
High in energy and protein: Concentrates provide animals with concentrated sources of nutrients for growth, reproduction, or production (milk, eggs, etc.).

Promotes faster growth: Due to their higher nutrient density, concentrates support quicker weight gain in livestock.

Increased productivity: Animals that are producing milk, eggs, or wool need concentrated energy and protein to meet the higher demands.

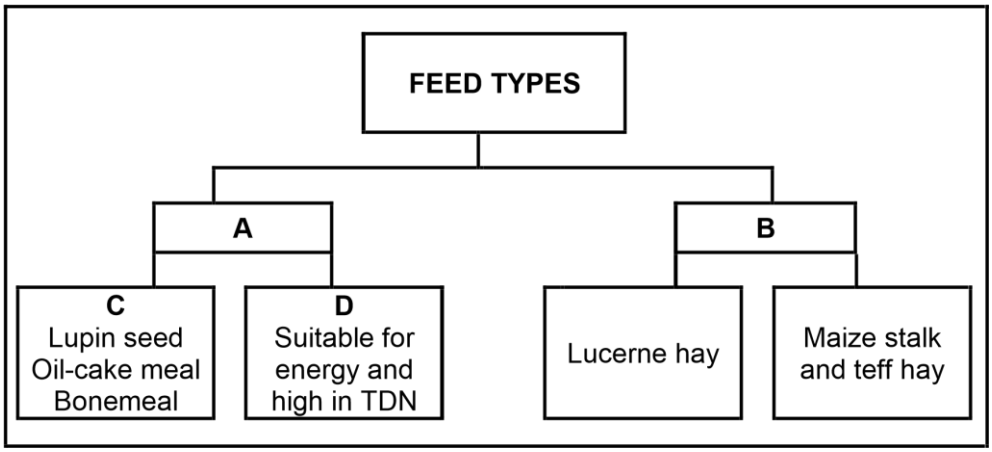
Easier to store and transport: Concentrates are often more compact than roughage, making them easier to handle and store.

3.1.5 Schematic representation of different types of animal feeds



1.2 Activities

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



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1.1 Classify feed types A and B. (2)
1.2 Identify the subdivision of feed type C. (1)
1.3 Give TWO examples of the subdivision of feed type D. (2)
1.4 Feed type B is mainly fed to ruminant animals. Give TWO reasons to justify this statement. (2)
[7]

2 The pictures below show different animal feeds available.

FEED A

FEED B

FEED C

FEED D

2.1 Classify the type of feed shown in FEED A and FEED C. (2)

2.2 Write down the letter (A–D) of the feed in the pictures above that can be recommended for farm animals under EACH of the following conditions:

(a) Finishing off of cattle for the abattoir (1)
(b) To correct mineral deficiency (1)
(c) To improve fertility in rams (1)
(d) To supply bulkiness in rations of ruminant animals (1)

2.3 Non-ruminants digest FEED B better when it is ground. Justify this statement. (2)
[8]

3. The information below shows the composition of the ration for farm animals:

Maize meal = 12%	Sunflower oilcake meal = 18%	Lucerne hay = 60%	Oats hay = 10%

3.1 From the information above, identify the feed that is an example of EACH of the following:

(a) Carbohydrate-rich roughage (1)

(b) Protein-rich concentrate (1)

3.2 Why is the ration in QUESTION 3.2 NOT recommended as the only source of food for lambs less than two weeks old? (2)

3.3 State ONE important point about grass hay in rations for mature ewes. (1)

[6]

UNIT 4: DIGESTIBILITY AND QUALITY OF FEED
EXAMINATION GUIDELINE AND OUTCOME
Digestibility of feeds
● Define the digestibility and digestibility coefficient of feeds
● Understand the different steps in the calculation of digestibility coefficient, interpretation and implication of calculated values
Quality of feed: biological value of proteins
● Define the concepts: biological value (BV), essential amino-acid index and ideal proteins
● Explain the importance of animal proteins in rations
● Evaluate a feed protein in terms of biological value (egg protein and milk protein)
Energy value of feed
● Name the units in which energy value is expressed
● Define and outline gross energy, metabolic energy, digestible and net energy
● 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
Nutritive ratio
● 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
Pearson square
● 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

IMPORTANT TERMS AND DEFITIONS	T
Digestibility refers to the proportion of a feed or nutrient that can be broken down and absorbed by the digestive system.	Digestibility
Biological Value is a measure of the proportion of absorbed protein from a food that becomes incorporated into the proteins of the organism's body	Biological Value
The Essential Amino Acid Index evaluates the quality of a protein based on its content of essential amino acids relative to a reference protein	Essential amino acid index
Combination of heat and potential energy	Gross energy (GE)
Energy available for maintenance, production, or growth	Net energy (NE)
The indicator of the protein content of a feed	Nutritive ratio

4 DIGESTIBILITY AND DIGESTIBLE COEFFICIENT OF FEED

The digestibility of a feed refers to the proportion of the feed's nutrients that can be broken down and absorbed by an animal's digestive system

4.1 Digestible Coefficient

The digestible coefficient (or coefficient of digestibility) is a numerical representation of digestibility of a feed and expressed as a percentage of dry material. It quantifies the portion of each nutrient in the feed that is digested and absorbed by the animal.

Formula:

$$DC = \frac{DM\,(intake) - DM\,(excrete)}{DM\,(intake)} \times 100$$

A cow eats 30 kg of concentrate with a moisture content of 10% and 16 kg material is excreted in the manure with a moisture content of 35%.

Use an appropriate formula to calculate the digestibility coefficient of this feed. Show ALL your calculations.

STEP 1: Change the value of feed and manure to dry value

Feed intake	Feed excrete(manure)
30kg × 10% = 3 kg (moisture) 30kg — 3kg (moisture) = 27kg (DM)	16kg × 35% = 5.6kg (moisture) 16kg — 5.6kg (moisture) = 10.4kg(DM)

Note: If the feed consumed and excreted does not contain moisture content, you exclude step 1 and go straight to step 2 with dry matter content provided

STEP 2: Use the formula to determine the coefficient of digestibility.

$$DC = \frac{DM\,(intake) - DM\,(excrete)}{DM\,(intake)} \times 100$$

$$¿ \frac{27\,kg - 10.4\,kg}{27\,kg} \times 100$$

$$¿ \frac{16.6\,kg}{27\,kg} \times 100$$

$$= 61.48\% \ / \ 61\%$$

4.2 Quality, energy value and nutritive ratio of feeds

Biological value (BV) of protein

Biological value is an index of the quality of protein in a feed and gives an indication of the ability of a specific feed protein to fulfil the nutritional needs of an animal. It is a measure of how much nitrogen is available for metabolism and growth. A feed with a high BV provides all of the amino acids needed by the

Importance of animal protein in rations

Animal proteins in rations are needed for three

processes in the body:

● Growth: Young animals need protein for

tissue growth.

es

Evaluating feed protein

The BV of egg protein is considered to be 100. This is because it contains all 10 essential amino acids, in the right proportions. The BV of milk as a feed protein is also relatively high, namely

4.3 ENERGY VALUE OF FEEDS

Units of energy value

Energy contained in feed is expressed in joules (J). To understand the flow of energy from feed through the animal body you need to understand some terminology

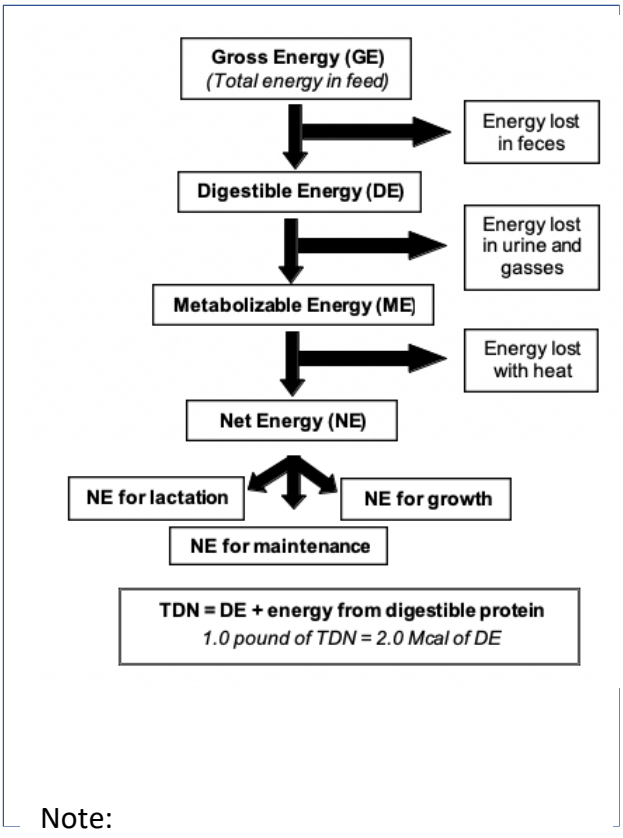
Gross energy (GE) is the total amount of chemical energy contained in feed. The gross energy of food is not the total amount of energy available to the animal because energy can be lost in various ways.

Digestible energy (DE) is the energy available after subtracting the energy lost in the faeces from the gross energy contained in the feed.

Metabolic (or metabolisable) energy (ME) is the energy available in feed after the energy lost in the excretion of urine and methane gas production has been subtracted from the digestible energy.

The nett energy (NE) is the quantity of energy that remains after the energy lost in the form of heat has been subtracted from the ME. It is the proportion of energy from the feed that is available for the animal to do work, grow, fatten, reproduce, lay an egg, produce milk and keep itself warm.

Schematic representation of energy in feeds



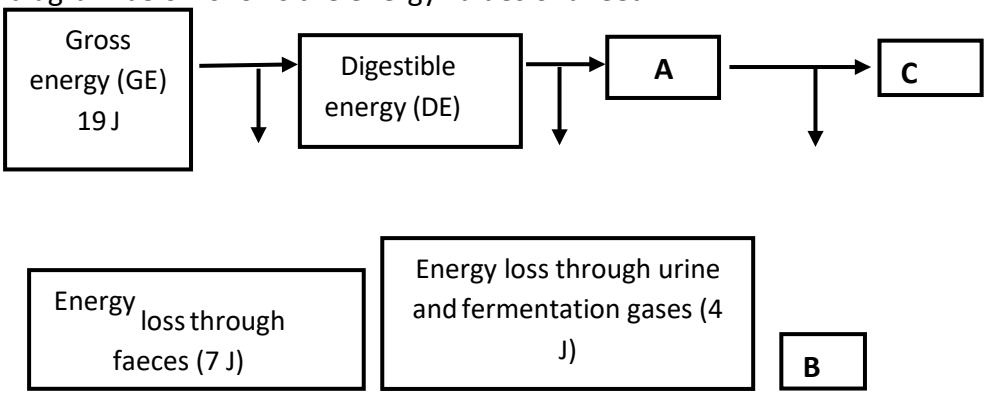
Note:

DE = GE – Energy in faeces

ME = DE – Energy in urine and methane gases

NE = ME –Heat energy lost

The diagram below shows the energy values of a feed.



(a) Calculate the energy value represented by **A**. Show ALL calculations. (2)

(b) Identify the energy loss in **B**. (1)

(c) Give TWO reasons why energy in **C** is important to farm animals. (2)

Solution

(a) GE- Energy -lost in faces-energy lost in in urine

= 19J- 7J – 4J✓

= 8J✓

(b) Heat production ✓

(c) Production✓

Work/maintenance ✓

4.4 Nutritive ratio

The nutritive ratio (NR) is an indicator of protein content of a feed. The nutritive ratio is the ratio between the digestible protein compound and the digestible non-protein compound (carbohydrates and fats) in a ration or feed.

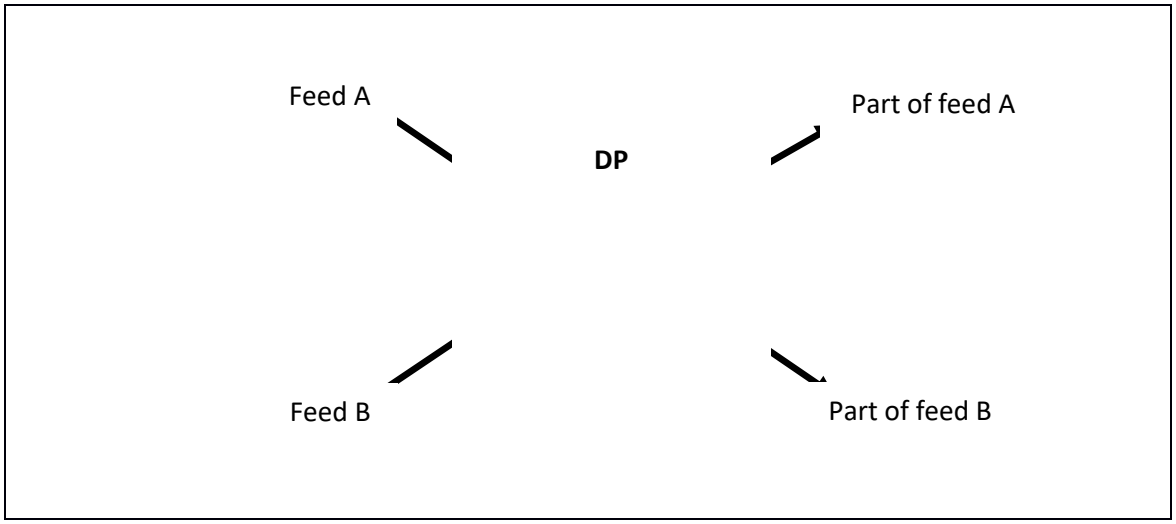
$$NR = 1 : \frac{TDN - DP}{DP}$$

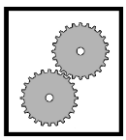
A feed with a highly digestible protein content will have a narrow nutritive ratio (NR < 1:6).
A feed with a low digestible protein content will have a wide nutritive ratio (NR > 1:6).

INTERPRETATION OF NUTRIVE VALUE OF FEEDS				
For maintenance	**For growth**	**For milk production**	**For reproduction**	**For Fattening**
NR between1:6 and 1:8 Protein needed for the replacement of tissue	NR 1:6 or less Lots of protein needed of high biological value	NR 1:6 or less Lots of protein needed of high biological value	NR less than 1:6 Lots of protein needed of high biological value	NR 1:9 - 1:10 carbohydrates only for maintenance

4.5 THE PEARSON SQUARE

It is used to calculate the quantities of each component that must be included in the feed mixture to get to required value. Pearson square method is a useful tool to determine the nutritional value of a feed mixture





Example

Problem:

Desired Digestible Protein Level: 16%

Ingredient 1 (maize): 8% Digestible Protein

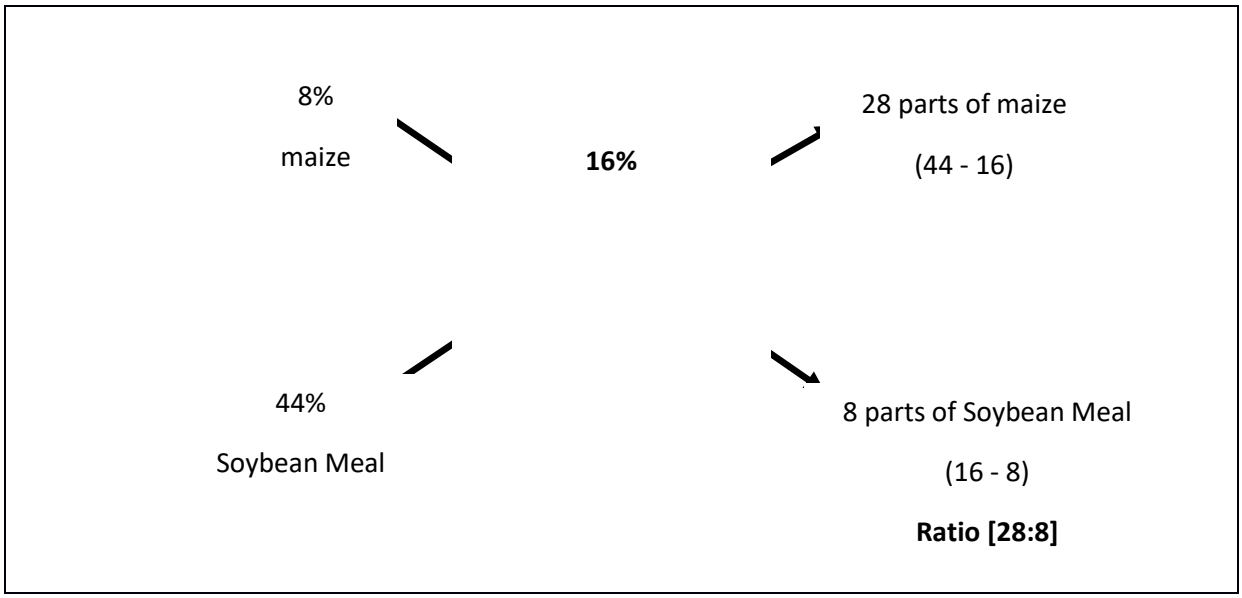
Ingredient 2 (Soybean Meal): 44% Digestible Protein

Step 1

Draw the square and place values:

STEP 2

Subtract values. Make sure the value for parts is always positive.



Calculate Proportions of feeds:	**Including masses: How much maize and soybean meal must be added to 230 kg of the mixture.**
Total parts = 8+28=36 maize: 28 ÷ 36 × 100=77.78% Soybean Meal: 8 ÷ 36 × 100 = 22.22% Answer: To achieve a 16% digestible protein mix: Use 77.78% maize.	77.78 % x 230 kg = 178.89 kg corn 22.22 % × 230 kg = 51.11kg soybean

1.3 Activities

1. A cow ingested 15 kg of hay with a moisture content of 10%, and egested 3 kg of dry manure. Calculate the coefficient of digestibility of the hay. (5)

2. The following information was used during a digestibility trial conducted on a group of ruminant farm animals:

   Dry material content of the feed = 88%

   Dry material content of the manure = 77%

   Manure excreted = 3,5 kg

   Average feed intake = 10 kg

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

   2.2 Explain the implication of the value calculated in QUESTION 2.2.1. (2)

[12]

3 The table below shows the gross energy value and the energy losses after 1 kg and 5 kg of a feed were consumed by a farm animal.

ENERGY	**VALUES (Joule / 5kg)**	**VALUES (Joule/5kg)**
Gross energy	18,5	95,5
Energy lost in manure	8.5	42,5
Energy lost in urine	1,2	6
Energy lost in heat	1,8	9
Energy lost in methane	2,5	12,5

3.1 Indicate the energy lost in manure if the farm animal consumed 5 kg of feed. (1)

3.2 Identify the gas with the highest energy loss in the table above. (1)

3.3 Calculate the amount of energy that will be available for growth and production in 1 kg of feed. (3)

4.

Animal feeds contain different nutrients, such as carbohydrates, proteins and fats, with different energy levels. It is important that the animals get the correct amount of each nutrient to fulfil their nutritional requirements.

4.1 Refer to the passage above and identify the feed nutrient that provides the most energy to farm animals. (1)

4.2 Indicate the unit in which the total energy of an animal is measured. (1)

4.3 It is important that the farmer calculates the energy value of the feeds. Give TWO reasons to support this statement. (2)

[9]

5. The table below shows the composition of two feeds (**A** and **B**).

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

5.1 Calculate the nutritive ratio (NR) of feed A. (4)

5.2 Identify the feed (A or B) that is most suitable for fattening animals. Justify your answer. (3)

5.3 Indicate the feed (A or B) that is most suitable for young, growing animals. Motivate your answer. (3)

6.1 The following are the nutritive ratios of different feeds:

Feed A – 1 : 4
Feed B – 1 : 10
Feed C – 1 : 8

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

6.3 Feed A is recommended for feeding a one-month-old calf. Justify this statement. (2)

[16]

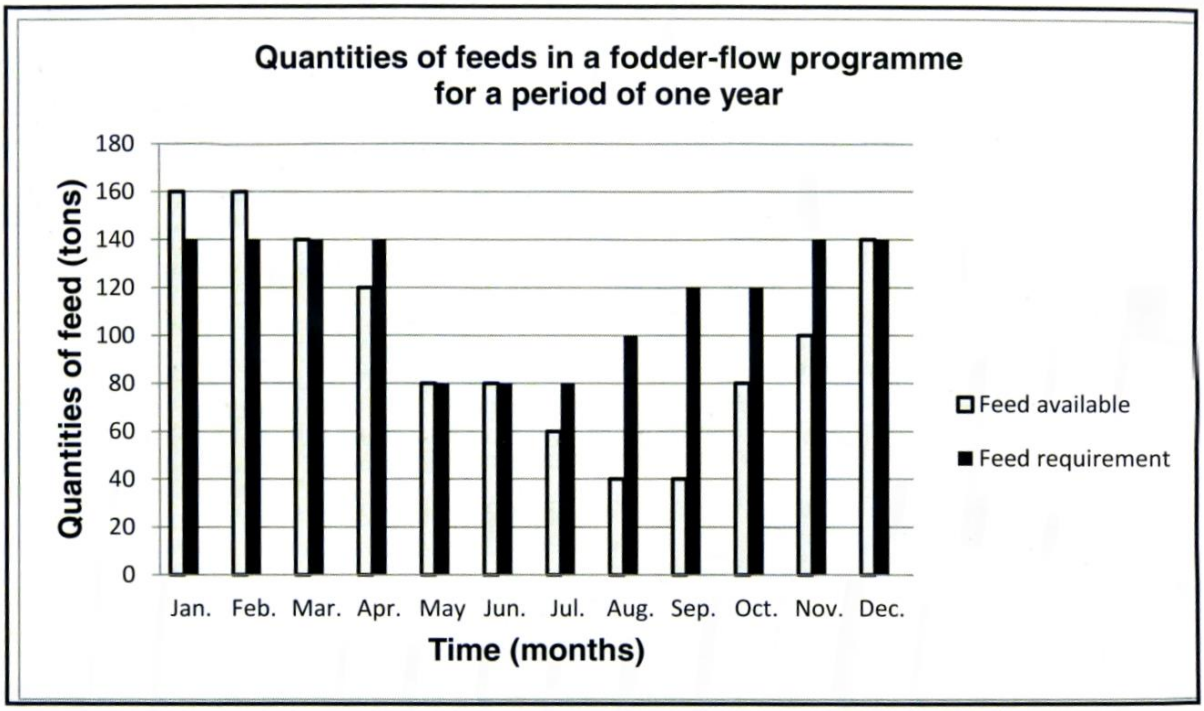
7. Maize and sunflower oilcake meal were used to prepare a balanced ration for farm animals. These animals need 18% digestible protein in their ration. Maize has a digestible protein content of 9% and sunflower oilcake meal has 38%.

7.1 Use the Pearson square to calculate the ratio of maize to sunflower oilcake meal needed in the feed mixture. (4)

7.2 Calculate the percentage of maize that is included in this mixture. (3)

[7]

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 available feed will be most insufficient for for the animals. (1)

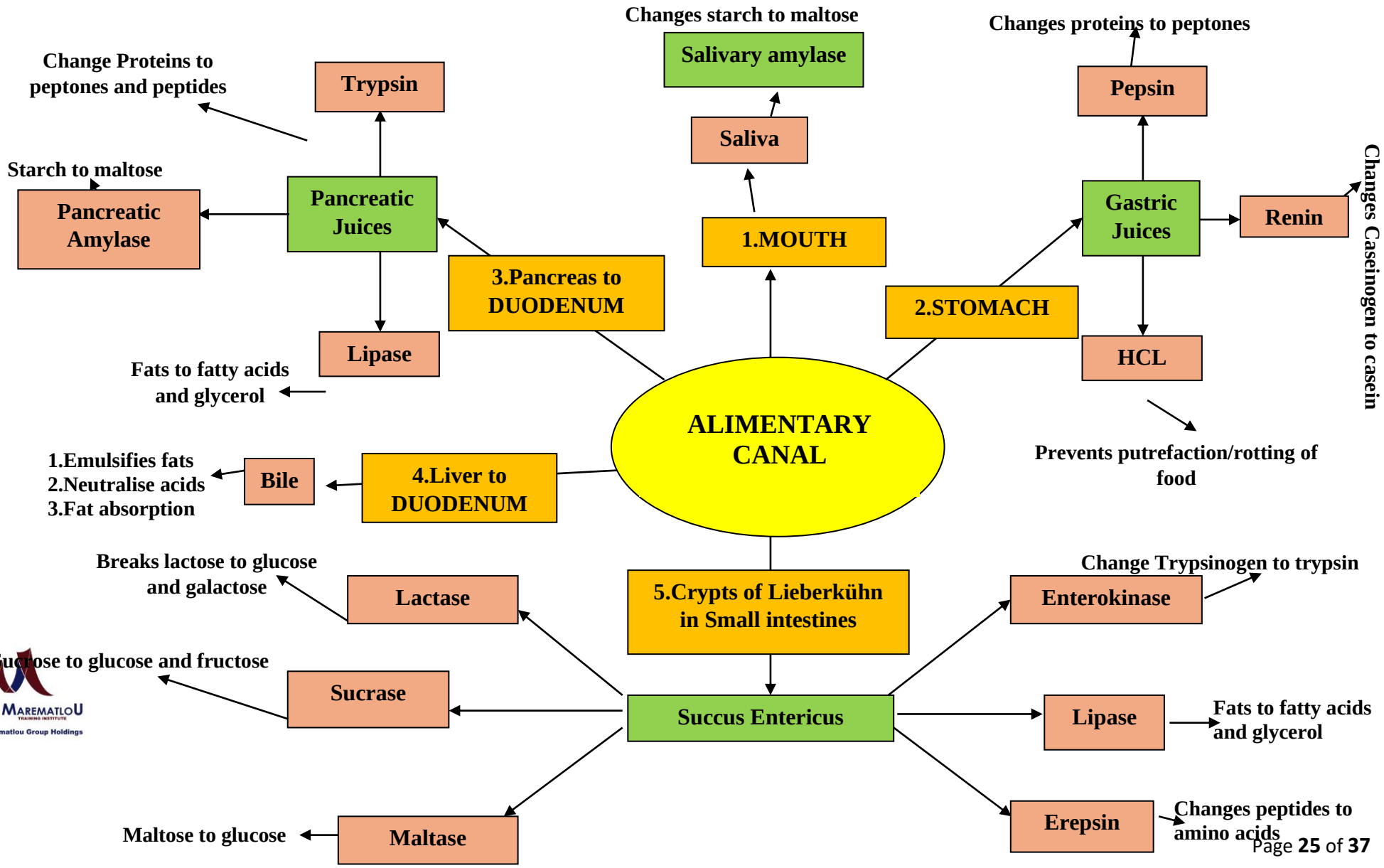
8.1.3 Calculate the shortage of feed during October in kilograms (kg). (3)

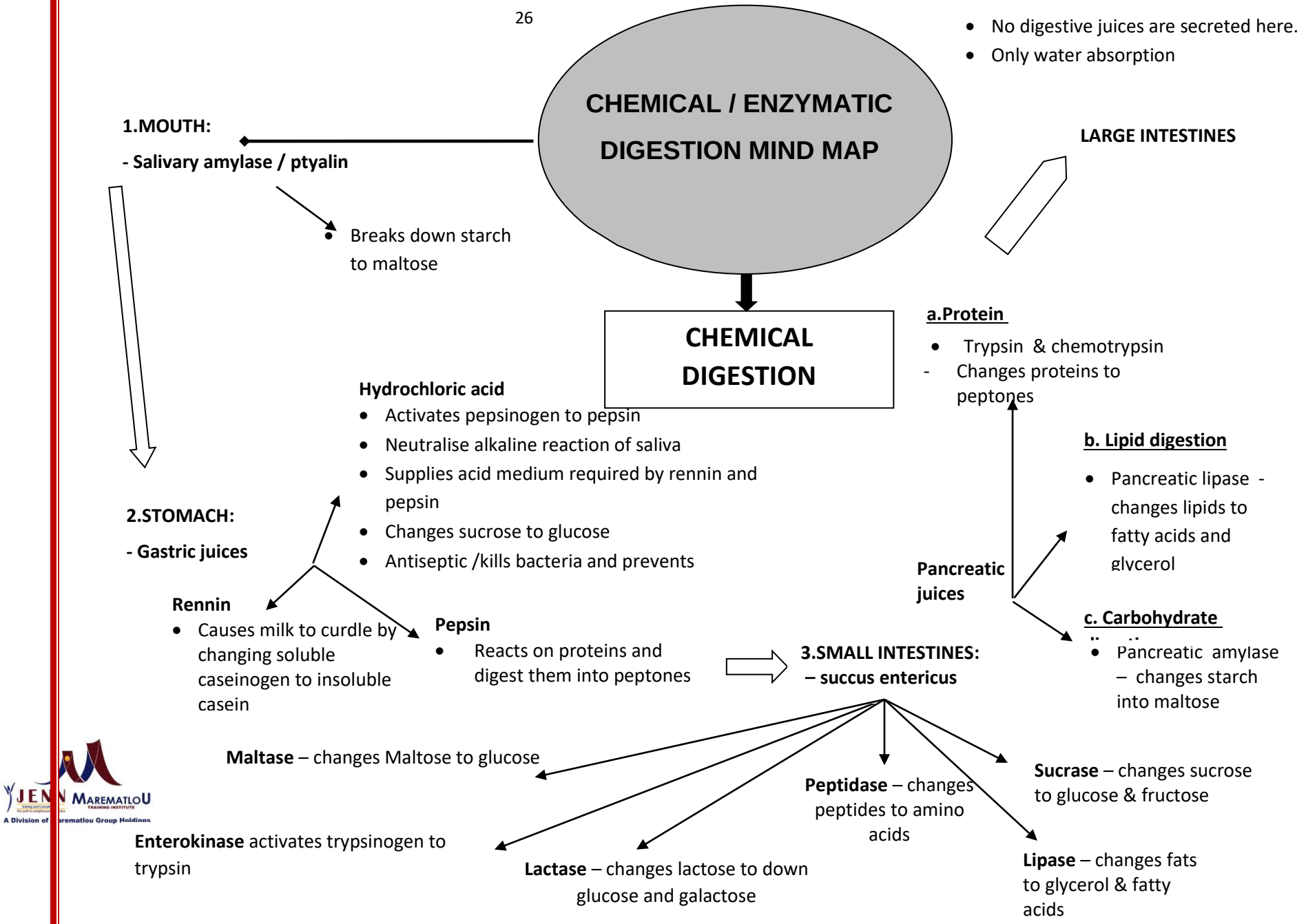
8.1.4 Suggest THREE cost-effective measures for better utilization of feed that could be applied in January and February. (3)

ALIMENTARY CANALS

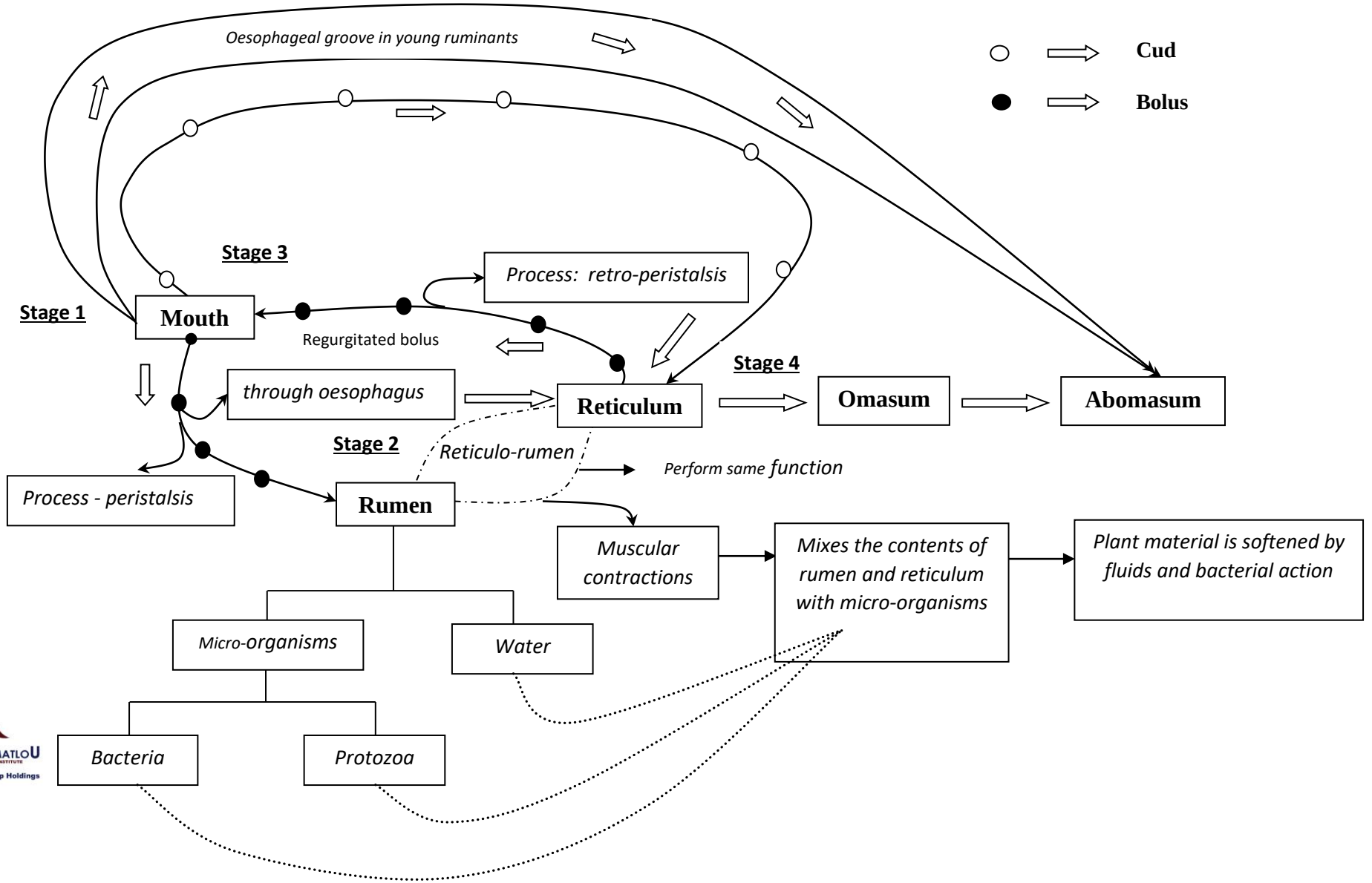
Alimentary canal	Pig	Cattle/sheep	Fowl
1. Mouth	• Thick upper lip & snout	• Broad thick lips hardly moveable	• No lips, but a horny beak
Teeth	• All four kinds of teeth - Incisors: 4 in each jaw - Canines: two in each jaw - Premolars: 8 in each jaw - Molars: 6 in each jaw	• Two kinds of teeth - No incisors in upper jaw, 8 in lower jaw - No canine teeth - Premolars: 6 in upper, 6 lower jaw - Molars: 6 in upper, 6 in lower jaw	• No teeth
Tongue	• Long, narrow, muscular, ends in a thin point	• Very movable, long and muscular, very rough surface	• Narrow, pointed, hardly any muscular tube
2. Pharynx	• Muscular tube 30 – 40 mm long	• Longer and wider than in pig	• Very short tube
3. Oesophagus	• Long narrow tube	• Same as in pig but longer approximately 1m.	• Dilates to form a bag-like enlargement - crop
4. Stomach	• Simple stomach and consist of - Cardiac sphincter - Cardiac ,Fundus, Pyloric - Pylpric sphincter	• Compound stomach and consist of - Rumen - Reticulum } Forestomachs - Omasum - Abomasum – True stomach	• Gastric complex consists of - Proventriculus (glandular) - Ventriculus /Gizzard(muscular)
5. Small intestines	• Very long narrow tube (approx. 15 m). Divided into: - Duodenum, Jejunum, Ileum	• Same as pig but much longer approximately 45 m long	• Same as pig but much shorter and small
6. Large intestines	• Shorter but much wider • Divided into caecum, colon, and rectum • Portion of the colon is sacculated	• Colon not as wide as in the pig and also not sacculated	• Two caeca, No colon • Short rectum • **Cloaca** in which both alimentary and uro-genital openings end
7. Anus	• External opening for defaecation	• Same as in pig	• External opening for defaecation and urination called the **vent**.

SUMMARY OF THE PRINCIPAL DIGESTIVE ENZYMES




CHEMICAL / ENZYMATIC DIGESTION MIND MAP
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
CHEMICAL DIGESTION
3.SMALL INTESTINES: – succus entericus
Maltase – changes Maltose to glucose
Enterokinase activates trypsinogen to trypsin
Lactase – changes lactose to down glucose and galactose
Peptidase – changes peptides to amino acids
Sucrase – changes sucrose to glucose & fructose
Lipase – changes fats to glycerol & fatty acids
Pancreatic juices
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
LARGE INTESTINES
No digestive juices are secreted here.
Only water absorption

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

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.

6. The absorption in small intestines (cont):

(Absorption by capillary blood vessels in the villi)

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

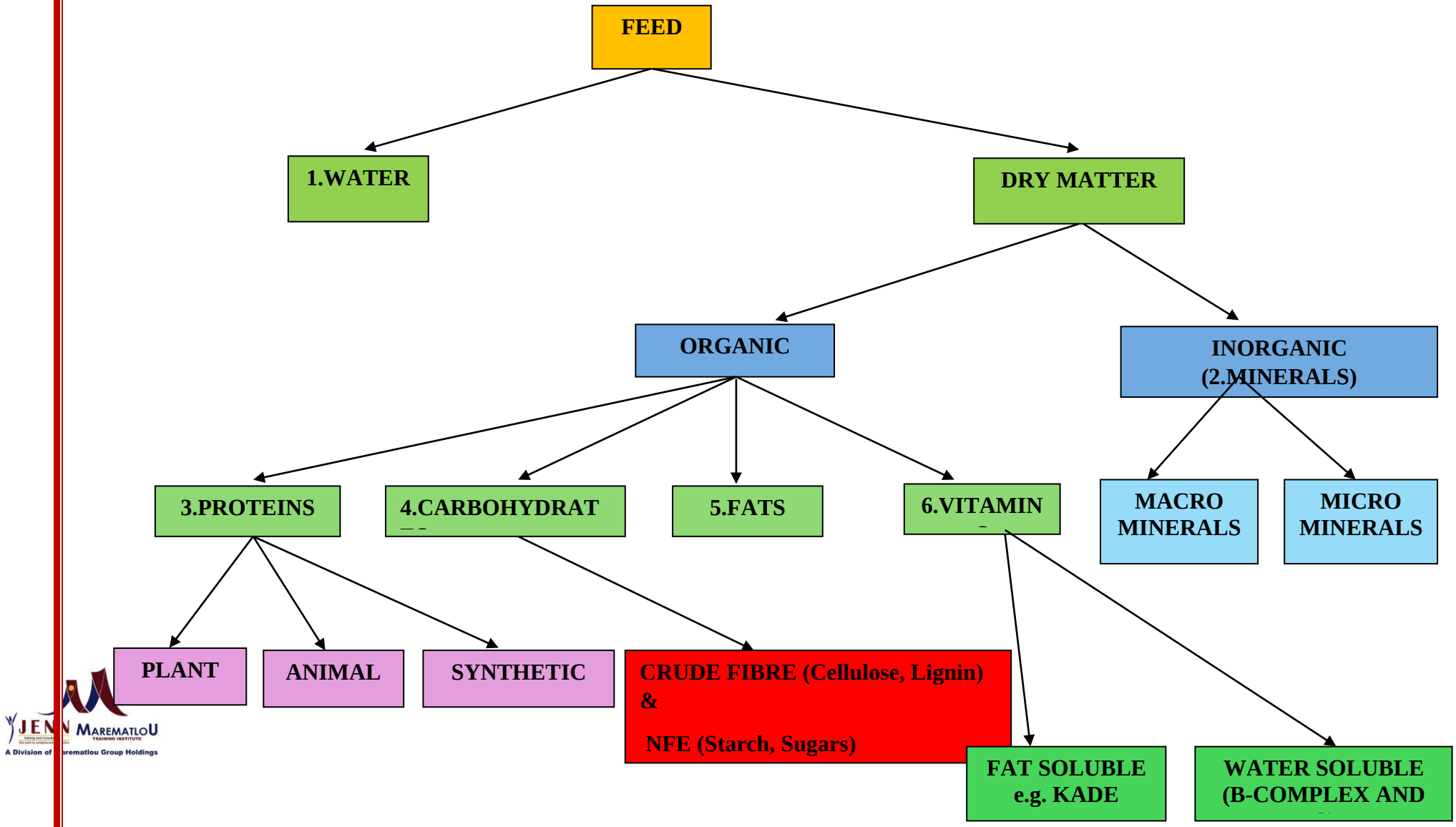
(Absorption by the central lymphatic system in the villi)

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

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

MIND MAP- COMPONENTS OF FEEDS



WATER SOLUBLE VITAMINS

VITAMINS FUNCTIONS AND DEFICIENCY SYMPTOMS/DISEASES

VITAMIN B_1

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 ad high mortality rate] [decreased lactation in cows][hens hatch fewer eggs]

VITAMIN B_2

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_6

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_{12}

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] [oestomalacia 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.

	Function	Deficiency symptoms	Sources
IRON	• Formation of haemoglobin • Activates various enzymes	• **Anaemia** • Paleness of mucous membranes • Listlessness, fatigue, diarrhoea	**Sources**: green forage
COBALT	• Building block of vitamin B_{12} • Normal digestion, growth and milk production • Synthesis of haemoglobin	• **Wasting disease** • Listlessness, loss of appetite • Low fertility, drop in milk production	**Sources**: green forage
IODINE	• Constituent of the hormone thyroxin	• **Goitre** • Low production capacity • Gives birth to hairless weak or dead young	**Sources**: marine salts
ZINC	• Healing of damaged tissues • Hair and feather development • Enzyme activity	• **Parakeratosis** • Keratinisation of wool	**Sources**: legumes
SELENIUM	• Antioxidant, glutathione peroxidise assist in vitamin E absorption and utilisation	• **Muscular dystrophy/White muscle disease** • Heart failure • Low fertility • Liver necrosis • Pancreatic fibriosis in chicks	**Sources**: forages and grains
COPPER	• Formulation of haemoglobin • Synthesis of hair and pigments • Normal bone formation • Tissue metabolism	• **Swayback (lambs)** • anaemia	**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

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 tha affect/influence the Digestibility of a feed :

1. Feed composition
2. Composition of ration
3. Preparation of feed
4. Type of animal

- Quantity of feed taken in
- Age of plant
- individuality

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 /%**

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

- **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

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 ✓

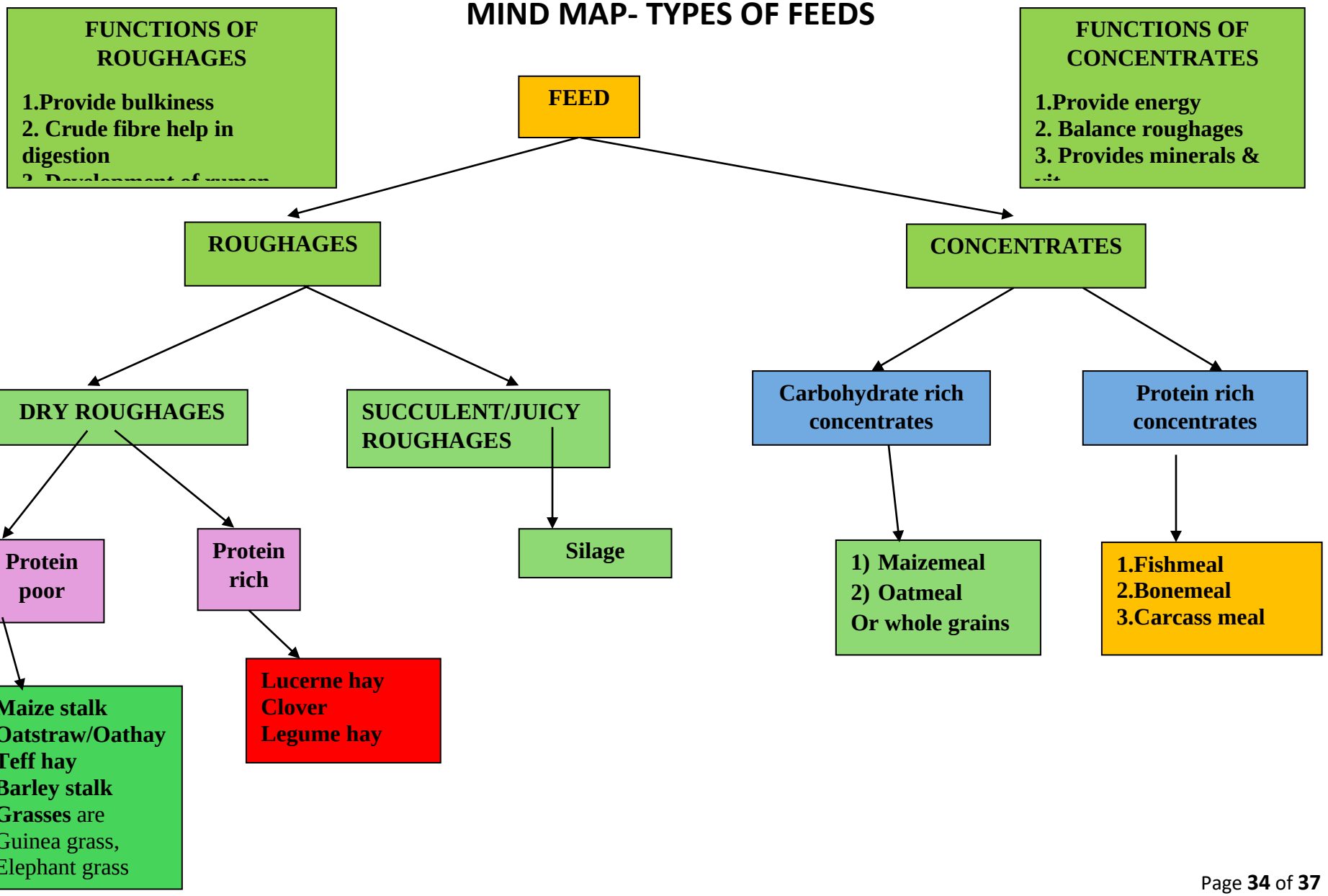
The Concept: Essential Amino Acid Index:

- ✓ 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**

MIND MAP- TYPES OF FEEDS



NUTRITIVE RATIO

Nutritive value of a feed:

✓ is the amount of a specific nutrient in a feed

example:

Nutrient	Value
Calcium	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 an indicator of the protein content of 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

Calculating the nutritive ration of a feed:

NR= 1: % Digestible non—nitrogen substances / % Digestible Protein or % DNNC / % DP or % Total Digestible Nutrients – % Digestible Protein / % 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	Requires carbohydrates and fats in large quantities	Requires carbohydrates and fats for maintenance	Sufficient carbohydrates and fats for maintenance and	Requires carbohydrates and fats for maintenance and

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

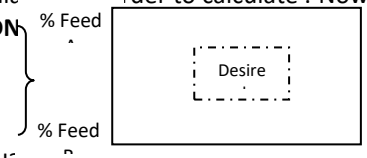
The Pearson's Square Method

- ✓ 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**

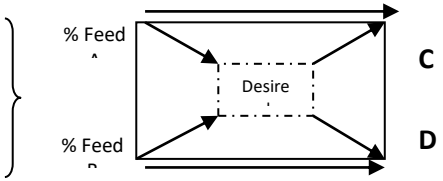


The method:

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:



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

- ✓ Subtract the value of the desired DP from the value of bottom right hand corner of the square [NB – this % v represented by C
- ✓ Subtract the value of the desired DP from the value of right hand corner of the square [NB – this value will re represented by D

Properties of a good fodder flow plan

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

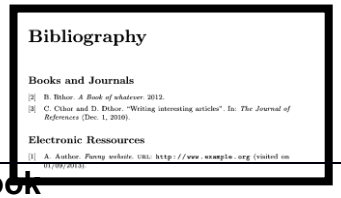
Fodder flow planning

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 (30x12 =360 days), 3 months(30x3=90days etc)



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1	**Focus Agricultural Sciences Grade 12 Learner's Book**
2	**Via Afrika Agricultural Sciences Grade 12 Learners Book**
3	**Previous question papers**
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TERM 1

ANIMAL PROTECTION AND CONTROL

TEACHER AND LEARNER CONTENT MANUAL

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ICON DESCRIPTION

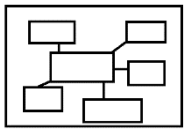
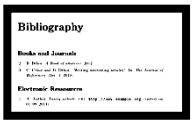
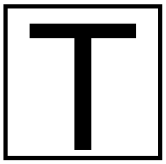
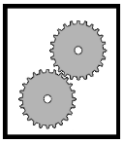
 MIND MAP	 EXAMINATION GUIDELINE	 CONTENTS	 ACTIVITIES
 BIBLIOGRAPHY	 TERMINOLOGY	 WORKED EXAMPLES	 STEPS

TABLE 1: AGRICULTURAL SCIENCES TERMINOLOGY.

IMPORTANT TERMS AND DEFINITIONS	
1. A device that measures body temperature	**Thermometer**
2. An abnormally high body temperature	**Fever**
3. Having a loose, watery stool during bowel movement	**Diarrhea**
4. Number of heartbeats in one minute	**Pulse rate**
5. Number of breaths in one minute	**Respiratory rate**
6. When one cuts open the carcass of dead animal to determine the cause of death	**Post-moterm**
7. When you examine animals for signs of disease	**Clinical examination**
8. The identification of a disease from the examination of symptoms.	**Diagnosis**
9. Disease that must by law be reported to authorities	**Notifiable/proclaimed**
10.Rapid spread of a disease more than it can be controlled	**Outbreak**
11.A disease outbreak that is consistently present and predictable in a particular area.	**Endemic diseases**
12.When a disease is prevalent or constantly present in a population and affects animals.	**Enzootic diseases**
13.Diseases that can be transmitted from animals to humans and from humans to animals	**Zoonotic diseases**
14.When a disease affects a large number of animals in a region or country.	**Epidemic**
15.When a disease has spread to other countries	**Pandemic**
16.Disease causing organisms such as virus, bacteria etc	**Pathogens**
17.Disease carrying organisms from infected to healthy animals	**Vectors / Carriers**
18.Very small single-celled microscopic organisms	**Bacteria and Protozoa**
19.Plant like organism that cause diseases to animals	**Fungi**
20.Device used to put a pill in an animal's mouth or throat	**Dosing gun**
21.Diseases that can be transmitted from one animal to another	**Infectious diseases**
22.Diseases that cannot be transmitted to other animals	**Non-infectious diseas**
23.Diseases caused by nutrient/mineral deficiencies in the body	**Metabolic diseases**
24.An organism that lives in 0R on an organism of another species for its food.	**Parasites**
25.Are parasites that attack the body surface of animal	**External parasites**
26.Protein substances produced by white blood cells in response to specific foreign antigens	**Antibodies**
27.Chemical compounds used to kill bacterial and fungal infections	**Antibiotics**
28.Keeping animals in isolation for a fixed period of time	**Quarantine**
29.An ability to infect other animals	**Contagious**

TOPIC 1: ANIMAL HEALTH

ANIMAL HEALTH: EXAMINATION GUIDELINES

Animal health

- Describe the signs of poor health/sick animals (cattle, pigs, and chickens)
- Name and describe the methods of testing animal health.
- Various methods of administering medicine to animals (cattle, sheep, pigs, and chickens)
- Describe the sustainable use of medication.
- Distinguish between infectious, non-infectious, and metabolic animal diseases.
- Identify and distinguish between the levels of seriousness of animal diseases (chronic, per-acute, and acute)

Signs of poor health in animals

1. Fever
2. Dull eyes
3. Dull coat.
4. Poor appetite
6. Lameness
7. Listlessness
8. Laboured breathing
9. Diarrhoea

Methods of testing animal health

1. Check Temperature
2. Check Pulse rate
3. Check Respiratory rate

Sustainable use of medicine

1. Don't medicate too often
2. Finish full treatment
3. Correct dosage
4. Safe use and check

Methods of administering medicine to animals

1. **Oral administration**/Dosing (through the mouth)
   - ✓ Dosing gun (pills, powders)
   - ✓ Drenching gun (liquids)
2. **Topical administration** (placed in the skin)
   - ✓ Ointments, creams, lotion, powders
3. **Injection**
4. **Dipping**

Infectious and non-infectious diseases

Infectious diseases – is transmittable from one animal to another.

(They are spread through the air, by direct contact, by contaminated dead carcasses or objects , by oral ingestion and transmitted by insects.

Zoonotic animal diseases include anthrax, rabies, ringworm and tuberculosis.)

Non-infectious diseases – cannot be transmitted to another animal.(Non-contagious).

Metabolic diseases are caused

Levels of seriousness

1. **In per-acute** – animals may drop dead(sudden death) within a few hours without showing signs e.g. Anthrax
2. **Acute** – symptoms develop rapidly but last for a short time (few days) e.g. FMD, RVF, Avian flu
3. **Chronic** - symptoms develops slowly over longer time(weeks to months), but fatal if it remains untreated.

   Chronic diseases tend to be more severe as they progress.

   Chronic conditions are often associated with non-communicable diseases/ not notifiable

TOPIC 2: ANIMAL DISEASES

Animal diseases

- Indicate the main micro-organisms causing diseases in animals
- Identify the most important diseases in South Africa based on the mode of transmission, animal host, symptoms and control measures

Viral and bacterial diseases

- Evaluate viral diseases, like foot and mouth disease (FMD), rabies, Rift Valley fever (RVF), avian/bird flu, swine fever/flu and Newcastle disease (NCD)
- Explain bacterial diseases prescribed, such as anthrax, mastitis and tuberculosis (TB): transmission, host,symptoms and control measures

Protozoal and fungal diseases

- Indicate protozoal diseases, like anaplasmosis, redwater, heartwater and coccidiosis
- Describe fungal diseases, like lumpy wool and ringworm
- Identify and explain the economic implications of these animal diseases
- Describe the preventative/control measures for animal diseases

The main micro-organisms causing animal diseases (PATHOGENS)

1. **Virus** - R, R, F, A ,N, S- (**R**abies, **R**ift Valley Fever, **F**oot and mouth disease, **A**vian/bird flu, **N**ewcastle disease, **S**wine flu)
2. **Bacteria** - A, T, M - (**A**nthrax, **T**uberculosis, **M**astitis)
3. **Protozoa** – 2 waters, 2 sis - (Red**water**, Heart**water**, Anaplasmo**sis**, Coccidio**sis**)
4. **Fungi** - L,R - (**L**umpy wool, **R**ingworm)

R

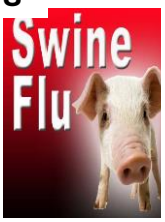
R

F

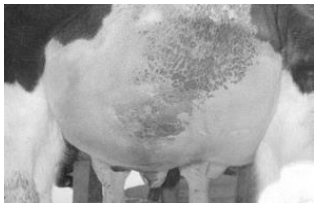
A

N

S



DISEASES **(VIRAL)**	TRANSMISSION MODE	ANIMALS AFFECTED	MAIN SYMPTOMS	CONTROL MEASURES
RABIES	Saliva through bite	Cattle, goat Sheep etc.	• Aggression • Excessive salivation	Vaccination, kill and dispose
RIFT VALLEY FEVER	Mosquito bites	Cattle, goat Sheep etc.	• Blood-stained nasal discharge, Abortion	Vaccination, kill and dispose
FOOT AND MOUTH DISEASE	Contaminated feed Secretions	Cattle, goat Sheep etc.	• Blisters in mouth • Sticky foamy salivation	Vaccination, Cull infected animals, Quarantine
AVIAN/BIRD FLU	Direct contact, inhalation,secretions	Chickens, birds	• Swelling of comb • Ruffled feathers	Vaccination, kill and dispose
NEWCASTLE DISEASE	Direct contact, inhalation,secretions	Chickens, birds	• Respiratory distress • Twisted necks	Vaccination, kill and dispose
SWINE FLU	Direct contact, inhalation, secretions	Pigs	• Vomiting • bleeding from the nose or rectum	Vaccination, kill and dispose



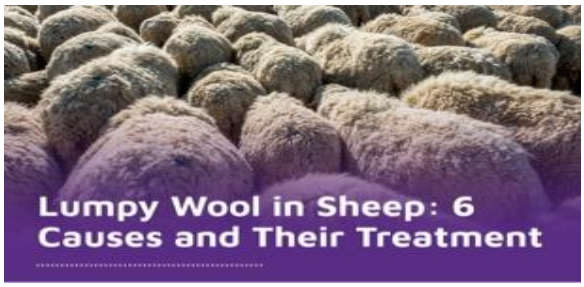
BACTERIAL DISEASES

DISEASES **(BACTERIAL)**	TRANSMISSION MODE	ANIMALS AFFECTED	MAIN SYMPTOMS	CONTROL MEASURES
ANTHRAX	Spores, biting flies, Contaminated feed	Cattle, goat Sheep etc.	Bloody discharge from nose, mouth, rectum Swelling of neck and throat	Vaccination, kill and dispose (bury or burn carcass)
TUBERTUTOSIS (TB)	Inhalation, secretions	Cattle, goat Sheep etc.	Soft, chronic coughs Increased breathing rate	Vaccination, kill and dispose
MASTITIS	transferred by the hands of the milker, by milking machines and by flies	Dairy Cattle, goat Sheep etc.	Udder is hot, swollen and painful Milk is thick flaky & may contain clots	Treat teats with germicide Apply antibiotics. Clean and

PROTOZOAL DISEASES

DISEASES **(PROTOZOAL)**	TRANSMISSION MODE	ANIMALS AFFECTED	MAIN SYMPTOMS	CONTROL MEASURES
REDWATER	One-host blue tick -BLUE TICK	Cattle only	▪ Urine is dark red or brown	Inject with Berenil Control ticks. Dip and vaccinate
HEARTWATER	three- host ticks - BONT TICK	Cattle, goat Sheep etc.	▪ Respiratory distress ▪ Unco-ordinated . Movements (high" stepping)	Inject with tetracycline Control ticks. Dip and vaccinate
ANAPLASMOSIS	Ticks and biting flies	Cattle, goat Sheep etc.	▪ Anaemia -Yellow and pale mucous membrane	Broadspectrum antibiotics. Control ticks, Dip and vaccinate
COCCIDIOSIS	Ticks and biting flies	Cattle, goat Sheep, poultry etc.	▪ diarrhoea containing blood	**Administer** anticoccidial drugs Sanitation

FUNGAL DISEASES



DISEASES **(FUNGAL)**	TRANSMISSION MODE	ANIMALS AFFECTED	MAIN SYMPTOMS	CONTROL MEASURES
LUMPY WOOL	Direct contact shearing equipment	Sheep ,goats	Lumps and scabs on the fleece	Jet and **dip with zinc sulphate.** Treat with **antibiotics Biological defieecing**
RINGWORM	Direct contact	Cattle	Hair loss **circular**	apply a **mixture of**

ECONOMIC IMPLICATIONS OF ANIMAL DISEASES

FOR COUNTRY	FOR FARMER	FOR WORKERS	FOR BUYERS
Loss of production	Loss of production		Shortage of products
Loss of income/GDP	Loss of income/Profit	Price increases	Price increases
Loss of international trade (Export and import bans)			
Cost of producing / buying a vaccine	Vaccination costs		
Cost of quarantine			
Veterinary services costs	Veterinary services costs		
Cost of Research			

PREVENTION MEASURES OF ANIMAL DISEASES	**CONTROL MEASURES OF ANIMAL DISEASES**
Vaccination /Immunisation	Treat bacterial and protozoal with **antibiotics**
Sanitation and good hygiene	Cull infected animals and burn or bury bodies
Quarantine and test imports	Quarantine infected animals

ACTIVITY 1 **(20 Marks; 20 Minutes)**

1.1 Define the term:

1.1.1 Notifiable diseases (2)

1.1.2 Respiratory rate (2)

1.1.3 Zoonotic (2)

1.1.4 Enzootic (2)

1.1.5 Endemic (2)

1.2 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.5) in the ANSWER BOOK, e.g. 1.6 E.

1.2.1 Before giving any treatment, the following precautions must be taken.

A Check the date of manufacturing the medicine

B The number of animals

C Correct treatment, dosage and period

D Medicine doesn't taste well (2)

1.2.2 Preventing diseases by vaccination involves...

A medicating against parasites

B monitorling the disease

C giving animals more water to drink

D providing a weakened pathogen to stimulate the body to build antibodies. (2)

1.2.3 Which ONE of the following viral disease is mainly transmitted by inhalation or is airborne.

A. Rabies

B. Anthrax

C. Rift valley fever

D. Swine flu. (2)

1.2.4 An example of an enzootic diseases include the following:

A Rabies

B Anthrax

C Newcastle disease

D Tubertulosis (TB) (2)

1.2.5 Consider the zoonotic diseases below that are notifiable.

(i) Anthrax
(ii) Avian flu
(iii) Foot and mouth disease
(iv) Newcastle disease

CHOOSE THE CORRECT COMBINATION

A (i), (ii) and (iii)

B (ii), (iii) and (iv)

C (i), (ii) and (iv)

D (ii), (iii) and (iv) (2)

1.2.6 Which of the statements below is most correct about Rift valley fever.

A Outbreaks of RVF in humans precede animal cases

B To control the spread of RVF involve protection against fly bites

C Outbreaks of RVF in animals precede human cases

D The is no risk of animal-to-human transmission. (2)

(22 marks)

ACTIVITY 2 **(20 Marks; 25 Minutes)**

2.1 The normal heartbeat and respiratory rates for pigs vary depending on the age of the pig. Below is a list of the rates for various ages:

PIG AGE	NORMAL RESPIRATORY RATE (bpm) - BREATHS PER MINUTE)	NORMAL PULSE RATE (HEART BEATS PER MINUTE) (bpm)
Newborn	60	250
Weaned pig	40	100
Growing pig	40	90
Finishing pig	35	80
Adult pigs	18	80

2.1.1 Draw a line graph to indicate the normal pulse rate and respiratory rate for pigs at various ages. (6)

2.1.2 Suggest the respiratory and the pulse rate of a sick adult pig respectively. (2)

2.2 The table below represents the vaccination plan that a farmer uses to prevent acute animal diseases on a farm.

DISEASE	PATHOGEN INVOLVED	MAJOR SYMPTOM OF THE DISEASE	FARM ANIMALS IMMUNISED	CONTROL MEASURE
A	Bacteria	Swelling of neck, causing respiratory distress and bloody discharge from the nose, mouth and rectum	**B**	Vaccinate, kill infected animals and dispose of their carcass
C	**D**	Dark red urine	**E**	**F**
Foot-and-mouth disease	Virus	**G**	Cattle, sheep and goats	**H**
Rift Valley fever	**I**	High fever, blood- stained nasal discharge and abortions	Cattle, sheep and goats	**J**

2.2.1 Complete the table above. Write only the answer next to the letter (A–J) in the ANSWER BOOK. (10)

2.2.2 Name the vectors for (a) redwater *and(b) rift* valley fever. (2)

2.2.3 Indicate the mode of transmission of Disease A to humans (2)

(20 marks)

ACTIVITY 3. **20 Marks; 25 Minutes)**

3.1 The Department of Agriculture reported several foot-and-mouth disease (FMD) outbreaks in different areas of South Africa. This led to a ban on the export of animals and their products. Veterinarians were then deployed to the affected areas and infected animals were separated from non-infected animals.

3.1.1 Indicate the pathogen that causes the disease in the scenario above. (1)

3.1.2 Give TWO main symptoms of foot-and-mouth disease in farm animals. (2)

3.1.3 Deduce how foot and mouth disease could cause mastitis in dairy cows. (1)

3.1.4 Identify, in the scenario above, TWO roles of the state regarding animal disease control. (2)

3.1.5 Suggest ONE word (term) for the last statement in the scenario above. (1)

3.1.6 Indicate the mode of transmission of foot and mouth disease (FMD) to animals and humans. (2)

3.1.7 State TWO economic impacts of foot-and-mouth disease on South. Africa. (2)

3.2 Swine flu, anthrax, foot-and-mouth disease, tuberculosis and rabies are all highly contagious and pandemic diseases. Some are zoonotic while others are enzootic. Most of these diseases are notifiable diseases. The diseases are caused by different pathogens which could be transmitted by either direct contact or inhaling infected air. Some can remain infectious for weeks or even many months. People can also be infected by eating animal products from affected animals.

3.2.1 Classify the **first two** diseases in the scenario above according to the pathogens that cause them. (2)

3.2.2 Explain the meaning of *zoonotic diseases*. (2)

3.2.3 Differentiate between endemic and enzootic diseases (4)

3.2.3 Identify TWO diseases in the scenario that could be transmitted by BOTH the direct contact and inhaling infected air. (2)

3.2.3 Explain why swine flu is regarded as enzootic? (1)

3.2.4 Give TWO roles of the state in controlling the spread of notifiable diseases such as anthrax, swine flu to other countries. (2)

3.2.3 State TWO economic impacts of animal diseases regarding giving treatment and medication to sick animals.
(2)

(26 marks)

ACTIVITY 4. **20 Marks; 25 Minutes)**

4.1 The table below shows symptoms of different diseases in farm animals.

	ANIMAL 1	**ANIMAL 2**	**ANIMAL 3**	**ANIMAL 4**
MAIN SYMPTOMS	Blood-stained nasal discharge and abortion or death of young	Bloody discharge from the mouth, nose, and rectum	Skin surface and fleece contains scabs or a crust	Urine is dark red or brown

4.1.1 Identify the diseases affecting animals **1**, **2, 3 and 4 r**espectively. (4)

4.1.2 Identify the animal suffering from a deadly bacterial disease. (1)

4.1.3 Name a pathogen that causes the disease in animal **3**. (1)

4.1.4 Classify the vector for the disease in animal **4.** (1)

4.1.5 State THREE precautionary measure a farmer can take to prevent the spread of the disease in animal **3**. (3)

4.1.6 Compare the diseases that affect animals **1 and 2** in terms of: (PLEASE TABULATE)

a. Pathogen that causes the disease (2)

b. Level of seriousness (2)

c. Mode of transmission (2)

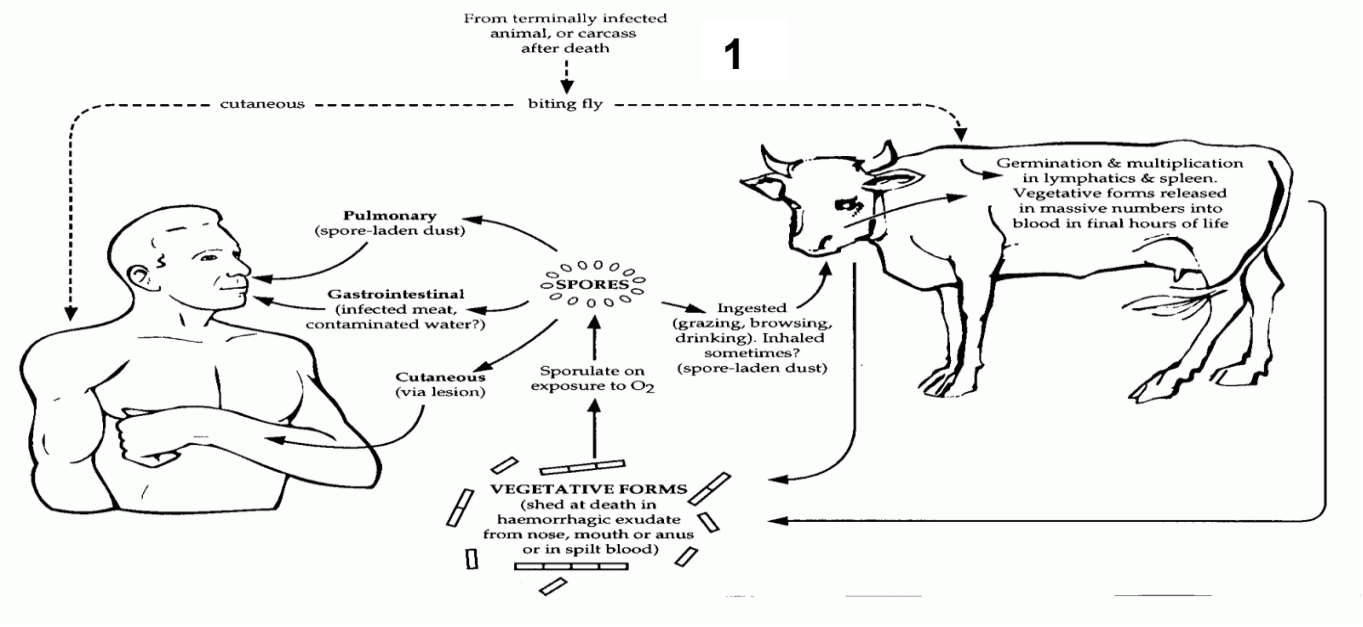
d. Animal hosts. (2)

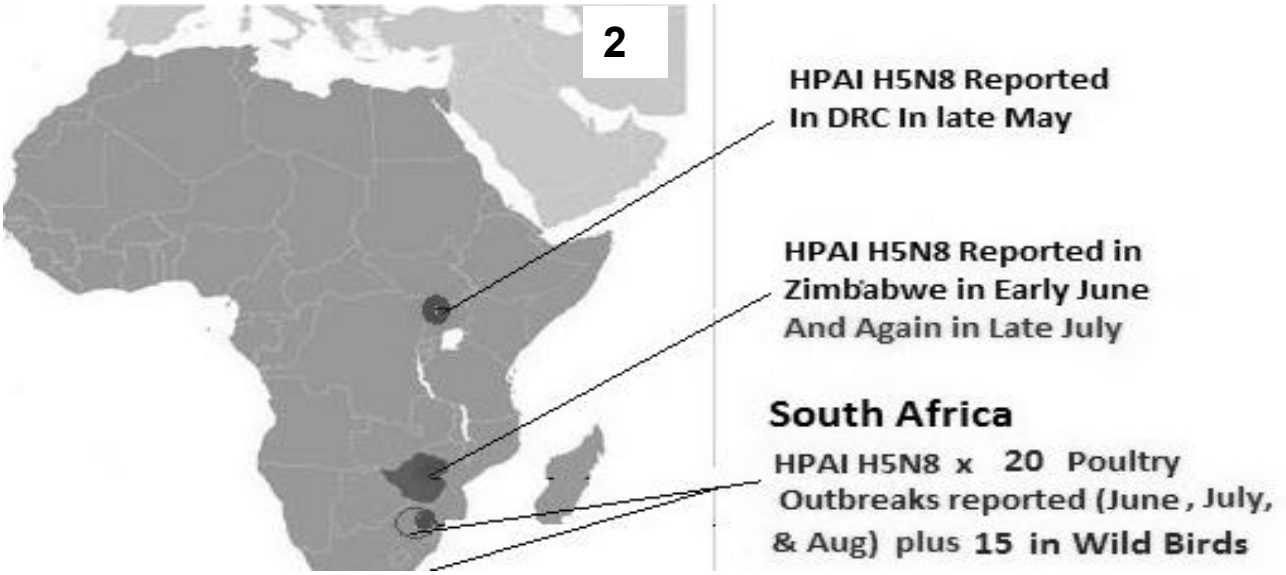
e. Control measure. (2)

TOTAL MARK:**(20)**

ACTIVITY 5. **20 Marks; 25 Minutes)**

5.1. STUDY THE PICTURES BELOW AND ANSWER THE FOLLOWING QUESTIONS:





5.1.1. Deduce the disease in pictures 1 and 2 respectively. (2)

5.1.2 Identify the animal host for disease in picture 2. (1)

5.1.3. Identify a term in picture 2 that means that the disease spread very fast

5.1.4. The disease in picture 1 spreads by means of spores, indicate any TWO ways in which these spores could be transmitted to humans. (2)

5.1.5. The disease in picture 2 is **pandemic** in Africa. Substantiate (2)

5.1.6. Suggest the economic implications of the disease in picture 2 for the South African consumers. (2)

ACTIVITY 6. **(33 Marks; 35 Minutes)**

6.1 The pig in the picture below appears to be very sick. Study the picture to answer the questions that follow.

6.1.1. List any THRE signs of poor health visible in the pig picture above.(3)

6.1.2. Taking temperature, pulse **rate**, and respiration readings can help you to gauge an animal's overall health. Name the device used to check temperature (1)

6.1.3. Comment on the temperature and the respiratory rate of the pig in the above picture. (2)

6.1.4. Give a short description of how you would go about checking the temperature and the pulse rate of the pig. (4)

6.1.5 The pig above may be suffering from a pathogenic disease or from a metabolic disease. Differentiate between these two types of diseases. (4)

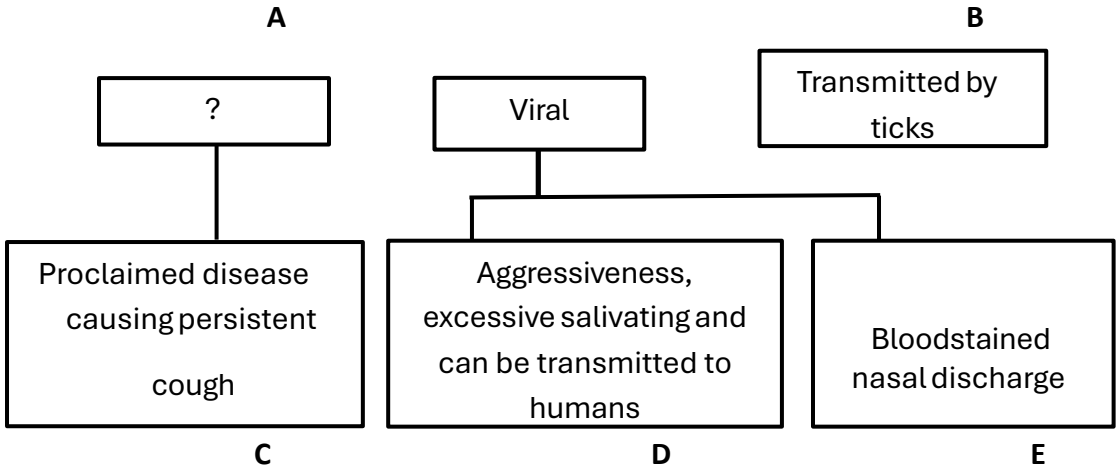
6.1.6. Give TWO examples of each disease type in Question 6.1.5. (4).

6.1.7. Indicate TWO ways to ensure that pig medication is sustainable. (2)

(20 marks)

ACTIVITY 7 **(33 Marks; 35 Minutes)**

The flow chart below shows the different farm animal diseases.



7.1.1 Identify the pathogen responsible for diseases **A** and **B**. (2)

7.1.2 Indicate the transmission mode of the virus for disease **D**. (1)

7.1.3 Name the vector that carries viral disease **E** during hot, wet seasons. (1)

7.1.4 Advise the farmer on a preventative measure for the occurrence of disease **E**. (1)

7.1.5 Suggest TWO measures the state can take to control the spread of disease **C**, once detected. (2)

TOPIC 3: PARASITES

PARASITES: EXAMINATION GUIDELINES

Internal parasites/Endoparasites

- **Define the term internal parasite**
- **Identify and describe the main groups of internal parasites, like tapeworms, liver fluke and roundworms**
- **Describe the life cycles, animal hosts, symptoms and treatment of tapeworms, liver fluke and roundworms.**
- **Explain the financial implications and detrimental effects of internal parasites**
- **Describe the basic preventative/control measures of internal parasites**

External parasites/Ectoparasites

- **Define the term external parasite**
- **Distinguish between ticks, nasal worm, blowflies, lice and mites as examples of external parasites**
- **Identify and describe the life cycles of ticks (single/two/three host ticks), nasal worm (sheep) and blowflies, lice and mites (sheep). ????**
- **Explain the financial implications and detrimental effects of external parasites**
- **Describe the basic preventative/control measures of external parasites**

IMPORTANT TERMS AND DEFINITIONS

Animal Pests	Organisms that live on or outside the host organism and share the same environment with the host
External parasites	are parasites that attack the body tissues such as blood, skin and hair of animal.
Internal Parasites	are parasites that live inside the host and rob it of its food and blood .
Biological control	is defined as 'any activity of one species that reduces the adverse effect of another

CLASSIFICATION OF PARASITES OF LIVESTOCK

There are two main types of parasites affecting livestock. These are:

1 External /Ecto-Parasites
2 Internal /Endo-Parasite

Internal Parasite.

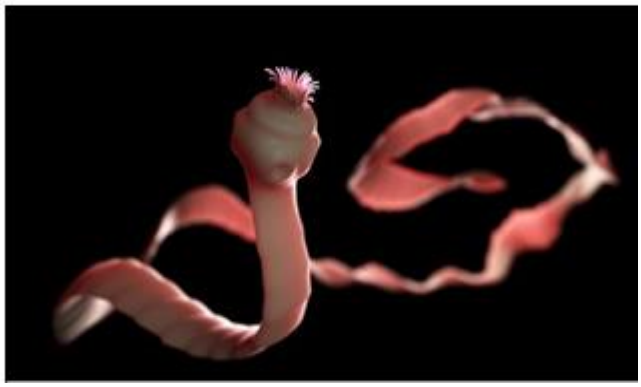
It is an organism that lives inside a host organism and derives it nutrient form the host

Main groups of internal parasites.

1 Tapeworms/cestodes
2 Liver fluke/Fasciola
3 Roundworms/

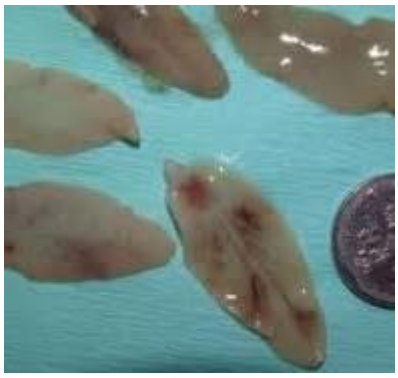
Tape Worm

Description :This is a long, narrow, and flat organism that lives in intestines of hosts organisms.

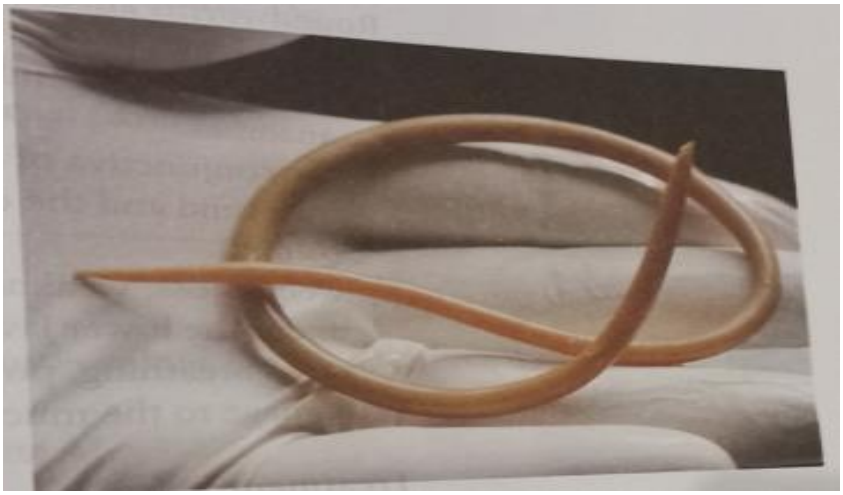


Liver fluke/Fasciola hepatica

Description: These are flat leaf-like flukes that live in the bile ducts in the host organism.



Roundworms/threadworm/Ascaris



These are small, white thread-like and live in the gut/alimentary canal and lungs of hosts.

Name of parasite	Life cycle	Animal hosts	symptoms	treatment
Tape worm	Eggs ↓ Larvae ↓ Nymphs ↓ Adults	Cattle, sheep and goats	Potbelly Stunted growth and reduced weight diarrhea	Dose animals with anthelhelmintics (dewormers
Liverfluke	Cattle, sheep and goats (eggs in faeces) ↓ Eggs hatch in water ↓ Larvae in snail ↓ Young flukes attach to grass. ↓ Cattle eat grass with fluke ↓ Adult fluke in liver of cattle	Cattle sheep and goats	Immature liverflukes causes liver damage. Adult liverflkues cause anaemia and bottle jaw.	Destroy snail and slugs with chemicals. Deworm animals through injections, drenches and pour-ons
Roundworms	Eggs in faeces ↓ Embryo in faeces ↓ Larvae on grass ↓ Adult roundworm in sheep	Cattle, sheep and goats	Anaemia. Death through toxin secretion which weakens animals	Dose with broad-spectrum anthelhelmintics

Financial implications	Detrimental effects of internal parasites
• Reduced farmer income/profits which impacts negatively on farm labourers	• liver fluke **causes liver damage**
• Stock losses due to death	• feed on blood and **cause anaemia**
• Loss of production	• Toxins **lead to black disease**
• High treatment/medicine	• Infested animals can get *wasting disease, oedema (bottle jaw)*
• *Labour costs will increase* at times of livestock treatment	•
• veterinary costs.	•

Preventative measures	Chemical Control measures	Biological control measures
Provide balanced nutrition to animals.	*Dose animals with the appropriate treatments/medicine*	Dung beetles are helpful in removing manure
Give animals clean drinking water.	Chemical medicines and remedies, such as anthelmintics,	Introduce natural enemies such as birds
Provide good hygiene	Deworming drugs	The use of micro fungi

Practice rotational grazing to break the life cycle of parasites	destroying the intermediate hosts (snails and slugs) by using flukicides	nematophagous mites and predacious nematodes
Breeding of animals that are resistant to parasite infestations		earthworms feed on animal faeces and contribute to the breakdown of faecal pats
Wet pastures must be avoided to prevent the snail hosts		
Resting of infested pastures		

EXTERNAL PARASITES

These are parasites that live on the skin of host organisms and feed on their blood.

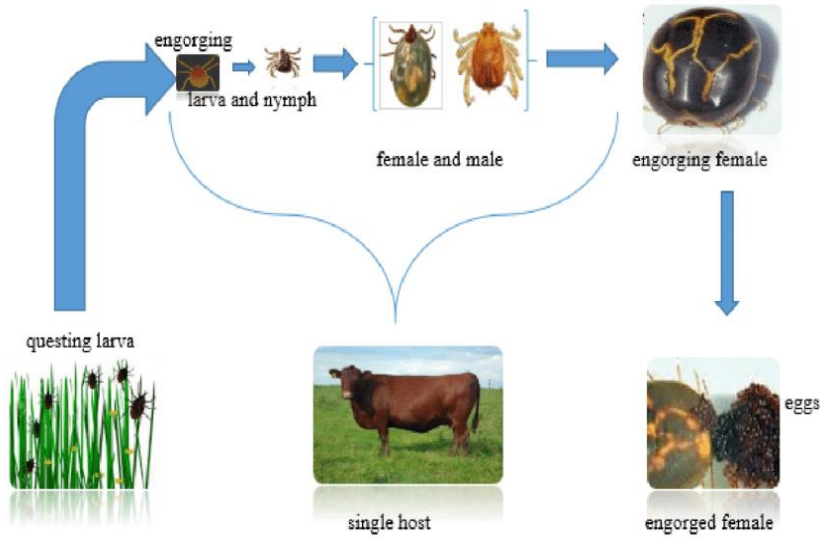
These include Ticks, Mites, Lice, Nasal Worm and Blowflies.

(Mi Ti Li Nas Blo). (Meat Li nice bro)

1.Ticks

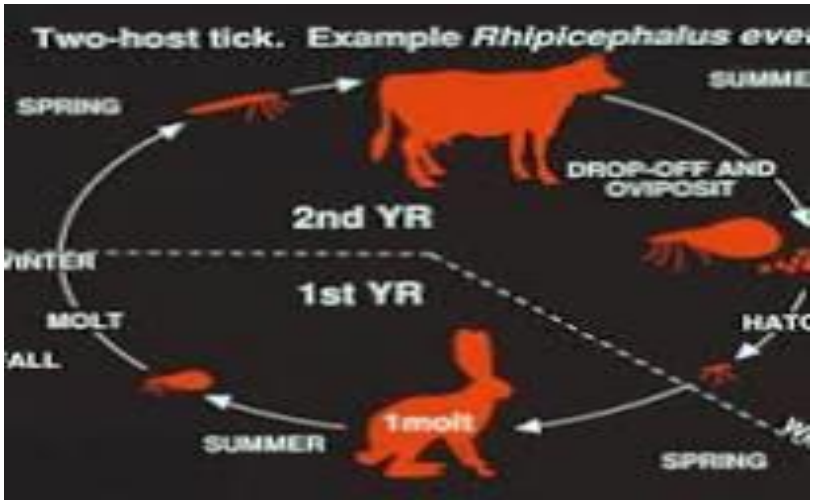
Suck blood and transmit diseases.

Ticks have eight legs and live on the skin of host organisms. They suck blood from the host and transmit diseases from an infested animal to previously uninfected animal.



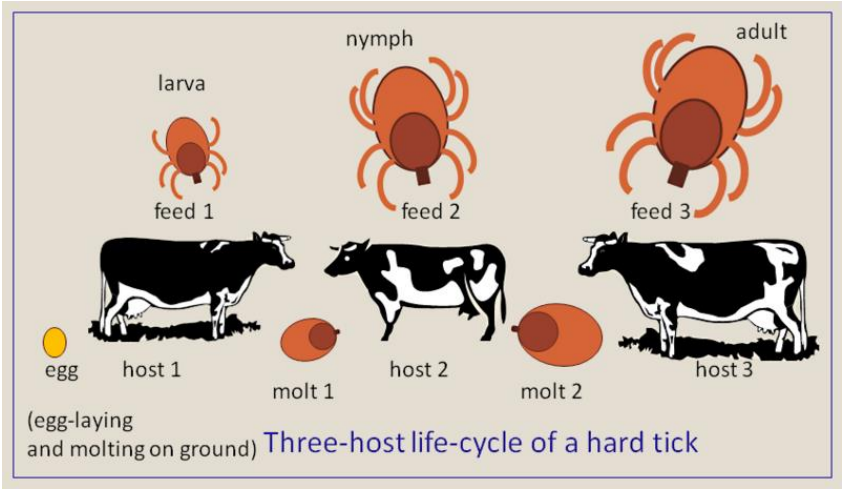
Life cycle of a single host tick

Blue tick



Life cycle of a two-host tick

Red legged tick



Life cycle of a three-host tick

Bont tick

Life cycles of ticks (simplified) **ELNA(Eggs, Larvae, Nymph, Adult)**

One-host ticks (Blue tick)	two-host ticks (Red-legged tick)	three-host ticks (Bont tick)
Eggs ↓ Larvae ↓ Nymphs ↓ Adults	Eggs ↓ Eggs hatch to six-legged larvae ↓ Larvae moults to nymph on first host ↓ Nymph moults into adult and attach to second host for feeding and mating	Eggs in winter ↓ Larvae in first host ↓ Larvae moults to nymph on second host ↓ Nymph moults in adult and leave second host ↓ Adult attach to third host for feeding and mating

Mites

Mites are very small and cause various diseases and problems.

Damage caused.

These are groups of insect-like organism which bite or cause skin irritations to their host organisms. They live on their hots for their entire life and infect the heads, body or tail area of their victims.

- Animals become restless.
- Loss of appetite

Lice

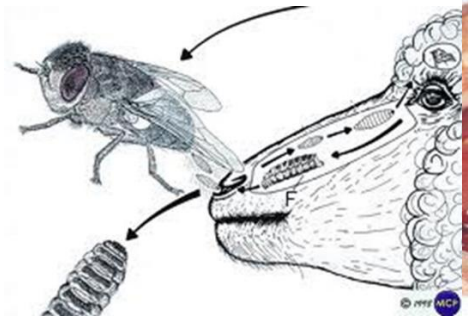
Lice live and multiply on the same host..

Lice are flat in structure and cause irritation and rubbing to cattle. There are **two** types which are : biting and chewing mouth parts

Damage caused.

- Skin irritations
- Inflammation
- Loss of appetite(anorexia)

Nasal worm



These are larvae of sheep bot fly. They only affect sheep and goats but not cattle.

Damage caused.

Fly lays the larvae around the nostrils during summer months.

- They cause irritation and infection.
- The maggot/larvae then enter the nasal cavity and feed causing severe thick yellowish discharge.
- Animal loses condition.

Blowflies

.

Blowfly strike mainly affect sheep which lay their egg on living sheep. They prefer warm and humid conditions. They prefer to attack the withers, flank and tail part of the sheep.

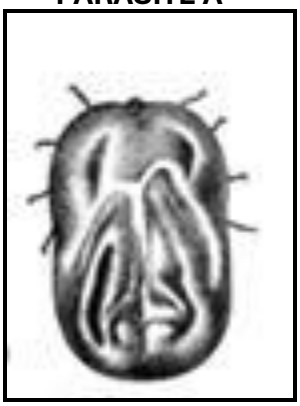
Financial Implications	Detrimental effects of External parasites
• Death of animals	• Skin damage
• Loss of income/profit	• Stress, restlessness and lack of appetite
• Chemical control is expensive.	• Painful bite wounds
• Loss of production.	• Open sores cause diseases
•	• loss of teats, ears and the tips of tails, and cause abscesses and lameness
• Both quality and quantity of wool is reduced	• Anaemia, as a result of the large volume of blood sucked .
• **cost of expensive equipment**	• Death due to large numbers of ticks.
•	• Irritation to animal
•	• External parasites can also act as vectors

Preventive and control measures for external parasites	Chemical control	Biological control
Use Integrated Pest Management (IPM) approach.	Use of insecticides as dusts, pour-ons	Introduce natural rnemies such as birds
Rest contaminated pastures.	Dose with chemicals	
Vaccinate cattle against tick-borne diseases	Apply chemical around the infested areas	Using insect growth regulators break the life cycle of the blowfly .
Practice good hygiene.	Inject chemicals such as ivomec & ivermectin	Keep poultry near water holes and animal shelters to eat the ticks
Tail docking	The chemicals that are used to treat cattle against ticks are called acaricides	
. Trapping of blowflies		

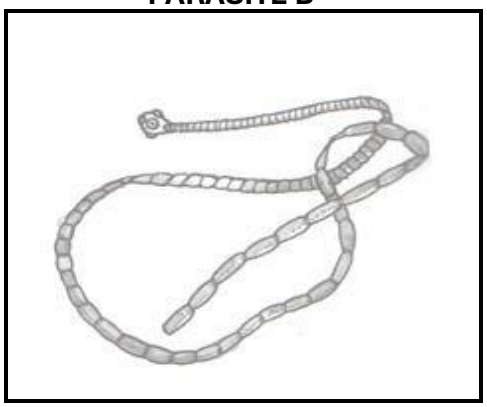
ACTIVITY 8**.** **20 marks. 25 minutes**

8.1 The pictures below show parasites affecting farm animals.

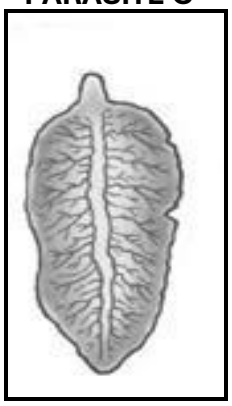
PARASITE A



PARASITE B



PARASITE C



8.1.1 Classify parasite **A and B and C** according to their life cycles.(3)

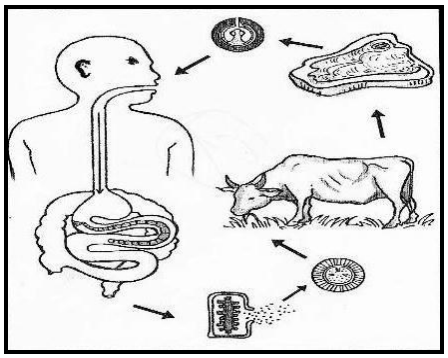
8.1.2 Name the protozoan disease that is transmitted by the parasite in QUESTION 8.1.1 (1)

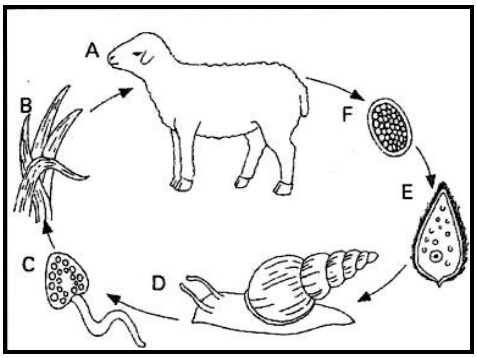
8.1.3 Write down the letter of the parasite to which EACH of the statements below applies:

(a) Its infestation can be controlled by destroying the snail.(1)

(b) It can cause bloated bellies in young animals. (1)

8.2 The diagrams below illustrate the life cycle of two different parasites.





8.2.1 Classify the parasite in **B**. (1)

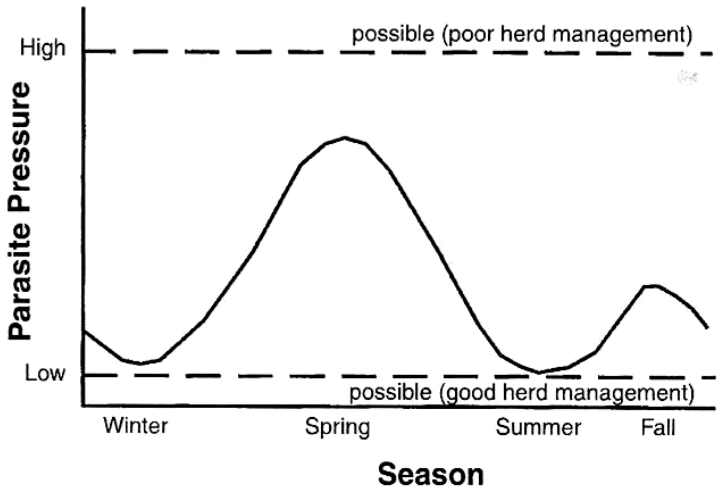
8.2.2 Name the parasites that are represented in **A** and **B**. (2)

8.2.3 State TWO biological measures that can be used to control the parasite **B**. (2)

8.3 Differentiate between the following pairs of terms:

(a) Internal and external parasite (4)

8.4 The figure below indicates the seasonal trends in the occurrence of parasites that vary with regard to season and management.



8.4.1 Name the season with the highest parasite pressure (infestation). (1)

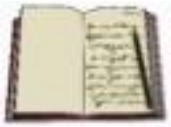
8.4.2 Give a reason for the high parasite pressure (infestation) during the season mentioned in QUESTION 8.4.1 above (1)

8.4.3 State TWO good herd management practices that may lead to less parasite pressure (infestation). (2)

8.4.4 Suggest a way of diagnosing parasite infestations. (1)

8.4.5 State TWO economic impacts of internal parasites. (2)

20 marks

ACTIVITY 9 Marks 20 Time 25 minutes 

9.1 The passage below deals with the infestation of bont ticks in livestock.

THE TICK CHALLENGE IN LIVESTOCK

Ticks play an important role as transmitters of diseases in animals, the type of which depends on the species of tick in question. Diseases such as redwater, gall sickness and heartwater are all acquired via tick bite and subsequent injection of the parasite that enters the bloodstream and causes the disease in the host animal. Production losses occur as a result of such tick-borne diseases by way of underperformance or even death of the infected animals.

Ticks with long mouth parts often create an opening in the skin of an animal that allows for the introduction of bacteria to deeper layers beneath the skin. This results in a loss of tail tips or ear lobes in cattle. In the eastern coastal regions of Southern Africa, the bont tick challenge has led to a loss of teat function in cows as a result of mastitis and abscesses in the udder.

[Source: *Farming SA*, September 2011]

9.1.1 Give TWO reasons why ticks are the most economically significant parasites in livestock farming by referring to the passage. (2)

9.1.2 Classify the bont tick according to its life cycle and give a reason to support your answer. (1)

9.1.3 Give a possible reason for a serious bont tick outbreak in the coastal region. (2)

9.1.4 Many fly species are also external parasites that bite and suck blood from their host. Name a fly species that attacks open wounds and tick bites in wool sheep breeds. (1)

9.1.5 Name TWO biological methods of controlling ticks. (2)

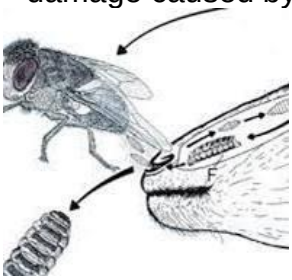
9.2 Mites are closely related to ticks but are much smaller and most cannot be seen by the naked eye. Mites are found on less hairy parts on the bodies of cattle, sheep, goats, pigs and horses.

9.2.1 Give a reason from the above extract to proof that mites are external parasites. (1)

9.2.2 Identify TWO non-ruminants in the extract that are affected by mites. (2)

9.2.3 Mites cause a proclaimed disease called mange. Explain a characteristic of this disease and name TWO responsibilities of the state in this regard. (3)

9.3.1 Identify the following livestock parasites and indicate one type of damage caused by EACH one of them.

(a) 

(b)

(4)

9.3.2 Briefly describe how a sheep farmer can control infestation by parasite in (a) above.

(2)

20 marks

TOPIC 4: PLANT AND METALLIC SALT POISONING

Plant and metallic salt poisoning: EXAMINATION GUIDELINES

Plant and metallic salt poisoning

- **Identify and describe the maize fungus, poison bulb, thorn apple as examples of plant poisoning**
- **Discuss the treatment of animals suffering from plant poisoning**
- **Describe the preventative/control measures of plant poisoning**
- **Identify and describe common salt and urea poisoning (the symptoms and treatment)**
- **Indicate the preventative/control measures of salt poisoning**
- **Describe the basic principles of good health to control animal diseases and parasites/pests**
- **Indicate the role of the state in animal protection**

IMPORTANT TERMS AND DEFINITIONS

Aflatoxin	is a mould that is produced by maize fungus and is carcinogenic.
Alkalosis	excessive blood alkalinity that is caused by high levels of bicarbonate in the blood
Carcinogen	is any substance that promotes the formation of cancer.
toxicity	level of being poisonous or toxic

Poisonous plants

There are several examples of poisonous plants to life stock. Examples are maize fungus, poison bulb, thorn apple. Some others are: ''tulp'', senecioscis, lantana and ''gif

Source of plant poison	Description
Maize fungus 	A toxic disease resulting from eating damp maize by livestock.
Poison bulb	This affects cattle that graze heavily on infested grazing land. Cattle are mainly infected when they graze on fresh leaves of poison bulb.

	
Thorn apple 	Seeds of the plant are poisonous and can cause death when eaten by cattle

Treatment of animals suffering from plant poisoning.

- Animals should be prevented from ingesting any more poisonous plants.
- Move animals to a clean camp.
- Do not give animals drinking water for up to two days.
- Chemical treatment with sodium permanganate followed by large doses of laxatives.
- Use activated charcoal in some cases.

Preventive and control measures of plant poisoning

- Keep animals in good condition during the dry season.
- Camp off areas containing poisonous plants.
- Avoid overgrazing pastures.
- Farmer must know poisonous plants in the area and keep animals away from them.

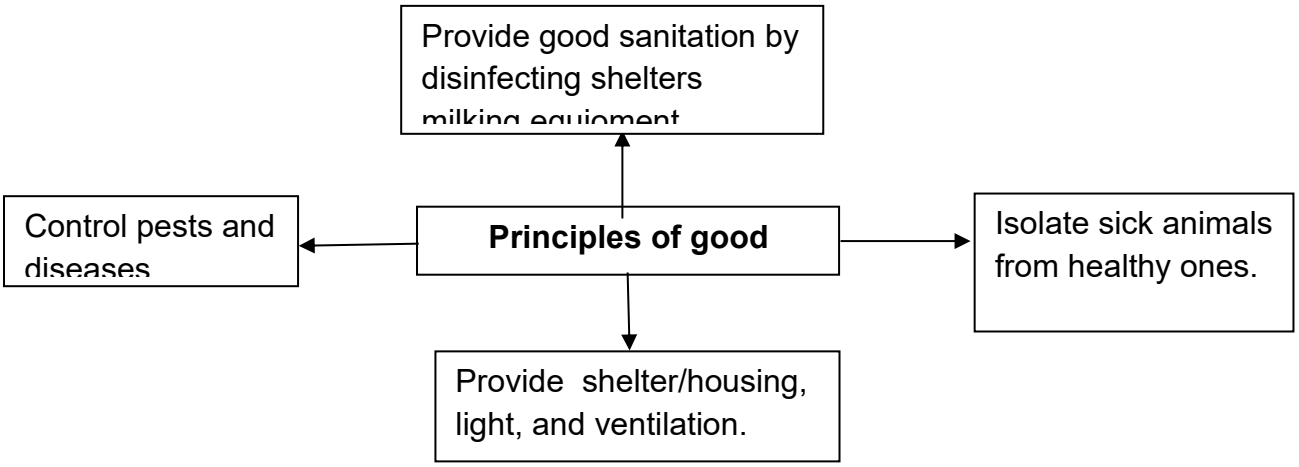
Metallic salt poisoning

Type of metallic poisoning	Symptoms	Treatment, Prevention, and control

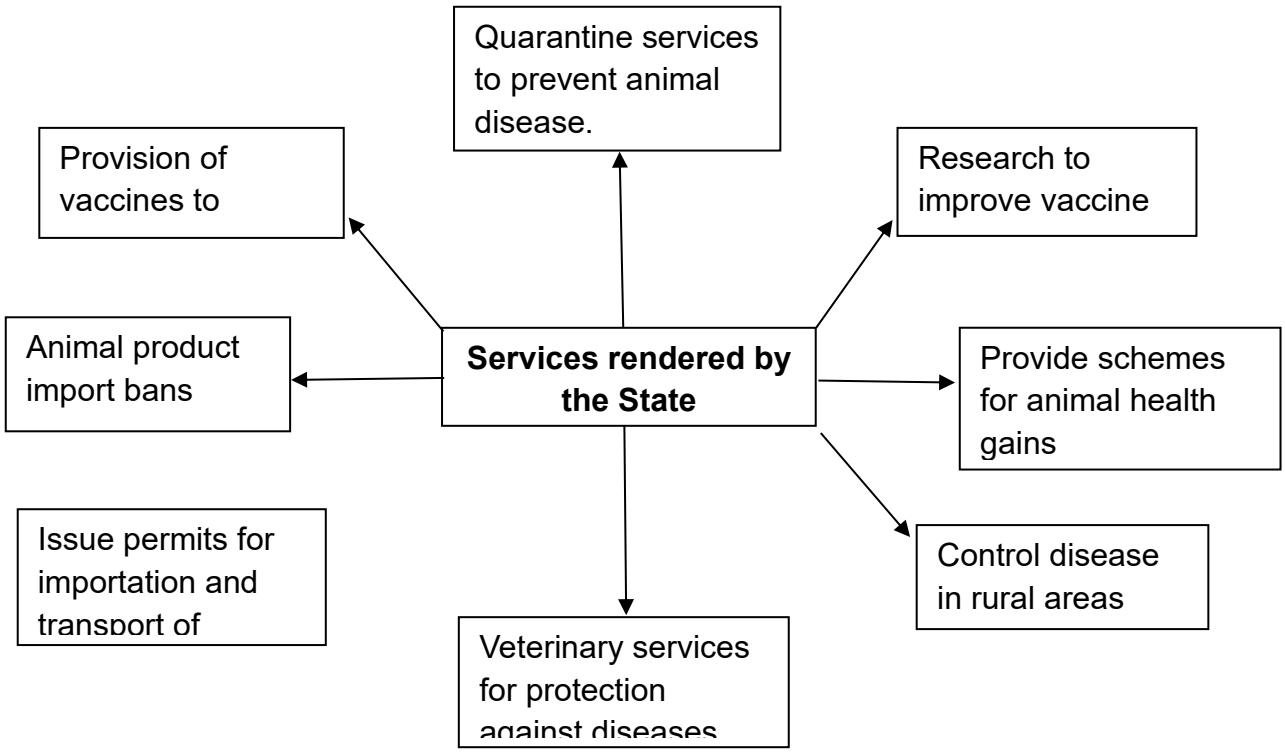
Common salt  Salt is one of the essential nutrients needed by all animals but seriously lacking in grazing pastures. It is supplemented mainly as mineral licks to cattle	• Acute sensitivity to touch • Excessive salivation • Constipation • Animal becomes thirsty.	• **Treatment** • Remove source of salt poisoning immediately • Provide small quantities of fresh water at short intervals. • Treat small animals with hypertonic dextrose solution **Prevention and control** • Camp off areas having poisonous plants. • Practice rotational grazing • Provide balance nutrition • Remove poisonous plants from pastures
Urea  **Urea is supplemented as non-protein nitrogen (NPN) in feed supplements to mainly ruminants. Excessive amounts in feed can poison animals.**	• Animals secrete saliva excessively. • Lack of balance/stagger and may die a few hours later. • Animals may bloat. • Painful muscular cramps(tetany) • Weakness and frequent urination	• **Treatment** Give vinegar to animals to neutralize the alkalosis. In severe cases, use stomach tube to administer the medication. **Prevention and control** • Urea supplemented should not exceed 1% of total ration. • Avoid feeding wet urea to cattle. • Give animals access to enough clean drinking water

TOPIC 5

Basic Principles of Good Health to control animal diseases and parasites.



Services rendered by the state in animal protection.



ACTIVITY 10

10.1.1 Define the following terms.

(a) Aflatoxin (2)

(b) Toxicity **(**2)

10.2 **Salts can be toxic to farm animals. Precautions should be taken to minimise the risk of salt poisoning.**

10.2.1 Give TWO symptoms of salt poisoning in farm animals. (2)

10.2.2 State TWO ways in which a farmer can treat an animal with salt poisoning (2)

10.3 Identify the control measures a farmer may take to prevent plant poisoning in EACH of the following situations:

10.3.1 Animals graze after being transported for a long distance (1)

10.3.2 Animals feed on hay kept in stables (1)

10.3.3 Overgrazed or overstocked camp (1)

10.4 Farmers need to be aware of plants that pose a danger to livestock because they are poisonous.

10.4.1 Name FOUR plants that are normally found on natural pastures and could be poisonous to animals. (4)

10.4.2 Indicate THREE measures the farmer can take to prevent plant poisoning. (3)

10.4.5 Identify TWO key roles played by the state in animal disease protection (2)

(20)

BIBLIOGRAPHY

1	Focus Agricultural Sciences Grade 12 Learner's Book
2	Via Afrika Agricultural Sciences Grade 12 Learners Book
3	Previous question papers
4	Mind the Gap Grade 12 Study Guide Agricultural Sciences

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AUTUMN CLASSES

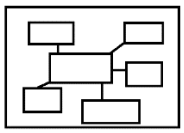
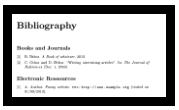
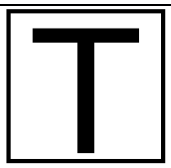
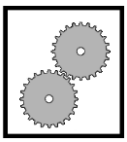
GRADE 12

TERM 1

ANIMAL REPRODUCTION

TEACHER AND LEARNER CONTENT MANUAL

ICON DESCRIPTION

 MIND MAP	 EXAMINATION GUIDELINE	 CONTENTS	 ACTIVITIES
 BIBLIOGRAPHY	 TERMINOLOGY	 WORKED EXAMPLES	 STEP

CONTENTS PAGE

TOPIC: ANIMAL REPRODUCTION

UNIT 1: MALE AND FEMALE REPRODUCTIVE SYSTEMS

EXAMINATION GUIDELINE AND OUTCOME

Reproductive organs of cattle

- Distinguish between the primary and secondary male reproductive organs/structures
- List the functions of the testes, epididymis, scrotum and the accessory sex glands (Vesicular glands; Prostate; Cowper's gland)
- Describe the process of sperm formation (spermatogenesis) and make a schematic representation of spermatogenesis
- State the factors causing sterility and infertility in bulls
- Identify and describe the primary and secondary female reproductive organs (structure)
- Indicate the functions of the ovaries, Fallopian tubes, uterus and vagina
- Describe the process of ovigenesis/oogenesis and make a schematic representation of ovigenesis/oogenesis

IMPORTANT TERMS AND DEFINITIONS	
Process of sperm production in the seminiferous tubules of the testes	Spermatogenesis
Process of ova formation in the ovaries	Oogenesis/Ovigenesis
Male glands that secrete fluids into the urethra to mix with sperms	Accessory glands
Sperm cells mixed with the fluids from the accessory glands	Semen

1. REPRODUCTIVE ORGANS

Primary reproductive organs are organs that produce male or female gametes and sex hormones. Secondary reproductive organs are all the organs that play a role in reproduction.

	Male	**Female**
Primary reproductive organs	Testes	Ovaries
Secondary reproductive organgs	Epididymis, Vas deferens, Penis, Urethra	Fallopian tube, urethra, vagina
Accessory glands	Versicular glands, Prostate gland, Cowpers glands	

1.2 FUNCTIONS

1.2.1 Male Reproductive System

1 **Epididymis**

Stores and matures and Transports sperm from the testes to the vas deferens.

2 Vas Deferens

Transports mature sperm from the epididymis to the urethra during ejaculation.

3 Penis

· Delivers sperm into the female reproductive tract. Organ of copulation in males

- Facilitates urination.

4. Urethra (Male)

Carries urine from the bladder to the outside. And Transports semen during ejaculation.

5 Vesicular Glands (Seminal Vesicles)

- · Produce seminal fluid, which nourishes sperm and facilitates their motility.

6 Prostate Gland

· Secretes fluid that forms part of semen, enhancing sperm motility and viability.

7 Cowper's Glands (Bulbourethral Glands)

· Produce a pre-ejaculatory fluid that neutralizes acidity in the urethra and provides lubrication.

8 Testes

- Produce sperm (spermatogenesis).
- Secrete testosterone, which is responsible for male secondary sexual characteristics.

1.2.2 Female Reproductive System:

1. Ovaries

- Produce eggs (ova) through oogenesis.

Secrete female hormones like estrogen and progesterone.

Fallopian Tube (Oviduct)

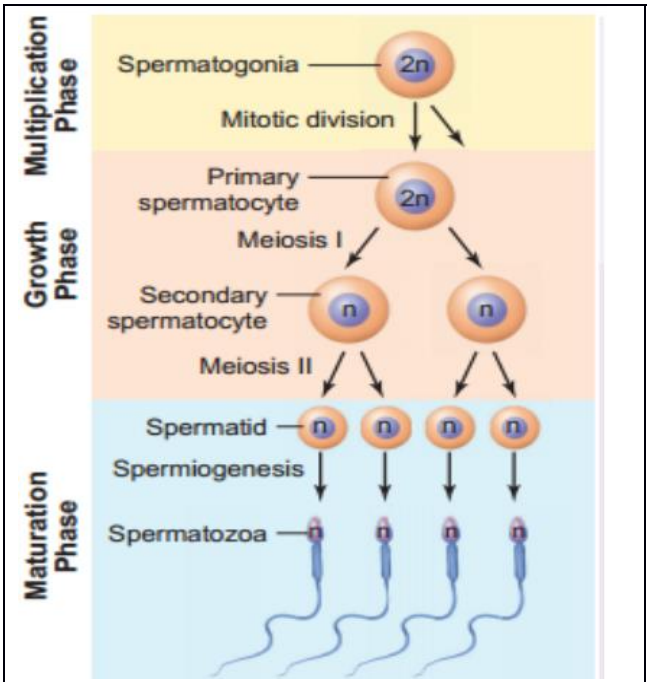
- Transports the egg from the ovary to the uterus.
- Site of fertilization in mammals.).

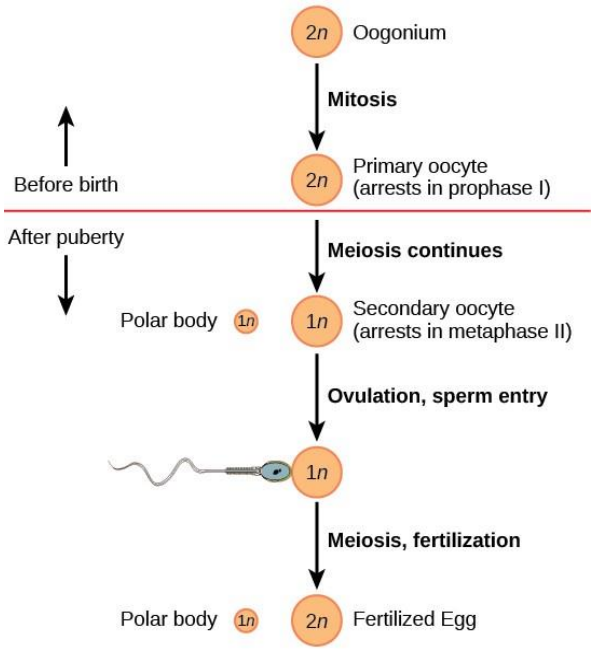
3 Vagina

- Serves as the birth canal.
- Receives sperm during copulation.

1.3 Spermatogenesis and Oogenesis

Spermatogenesis	Oogenesis
Spermatogenesis is the process by which male gametes (sperm) are produced in the testes. It occurs in the seminiferous tubules of the testes and involves both mitotic and meiotic divisions, as well as the differentiation of germ cells into mature spermatozoa.	Oogenesis is the process of producing female gametes (ova or eggs) in the ovaries. It involves the growth and differentiation of germ cells and includes mitotic divisions, meiotic divisions, and maturation. Unlike spermatogenesis, oogenesis is a discontinuous process





Factors causing infertility and sterility in bulls

Sterility is a total loss of fertility. Factors causing sterility are:
Castrating (caused by human),
Deformed reproductive organs, injuries, lack of libido and disease.
Congenital defects: Cryptorchidism, hypoplasia, hermaphroditism, sperm defects
Infertility is temporary loss of fertility. Factors causing infertility are:Imaturity and incorrect functioning of reproductive organs

1.3 Basic factors causing sterility and infertility in females (cows)

Factor	Description
Genetic Factors	refer to the inherited traits and variations in genes that can influence an individual's characteristics
Hormonal Imbalances	Anovulation, cystic ovaries, or progesterone deficiencies.
Uterine Infections or Diseases	Endometritis, pyometra, or metritis affecting the uterus.
Ovarian or Uterine Abnormalities	Ovarian tumors, uterine prolapse, or scarring.
Nutritional Factors	Poor or imbalanced nutrition, obesity, or malnutrition.
Environmental and Stress Factors	Heat stress, poor housing, and seasonal effects.
Reproductive Tract Injuries	Trauma or scarring of reproductive organs affecting fertility.
Poor Breeding Management	Improper AI timing, handling of semen, or use of poor bulls.

UNIT 2: OESTRUS AND OESTRUS CYCLE
EXAMINATION GUIDELINE AND OUTCOME
● Define oestrus or the heat period ● Identify and describe the female sex hormones and their respective functions ● Indicate and describe the periods/stages/phases of the oestrus cycle in cows ● Noticeable signs/characteristics of oestrus in cows ● Describe the practical methods dairy farmers can adopt to assist with the identifying of cows on heat

IMPORTANT TERMS AND DEFITIONS	T
Physiological and behavioral state in female mammals, during which they are sexually receptive and capable of conceiving	Oestrus
The physical act of sexual reproduction between two individuals, typically involving the transfer of male gametes (sperm) to the female reproductive system	Mating/Copulation

1 Oestrus and oestrus cycle

Oestrus (also spelled estrus) or the heat period is a phase in the reproductive cycle of female mammals during which they become sexually receptive and capable of conceiving. This period is characterized by behavioral, hormonal, and physiological changes that signal fertility and readiness to mate.

1.1 Female sex hormones and their functions

The female reproductive system is regulated by several key hormones, each playing a vital role in sexual development, reproductive processes, and overall hormonal balance. The primary female sex hormones are estrogen, progesterone, and follicle-stimulating hormone (FSH), luteinizing hormone (LH), and oxytocin.

1.1.1 Oestrogen - produced by the Graafian follicle within the ovary.

· Promotes the development of female secondary sexual characteristics.

· Regulates estrous behavior, making females receptive to mating (e.g., standing heat).

· Stimulates growth and maintenance of the uterine lining in preparation for pregnancy.

1.1.2. Progesterone -Secreted by the corpus luteum after ovulation and by the placenta during pregnancy (in species where the placenta takes over this function).

- Maintains pregnancy by inhibiting uterine contractions and preparing the uterus for embryo implantation.

- Suppresses estrous behavior during pregnancy.

-Prepares mammary glands for milk production.

1.1.3. Follicle-Stimulating Hormone (FSH) -Produced by the anterior pituitary gland.

- Stimulates the growth and development of ovarian follicles, which contain the oocytes (eggs).

- Promotes estrogen production in the follicles.

1.1.4. Luteinizing Hormone (LH) - Also produced by the anterior pituitary gland.

-Triggers ovulation by causing the dominant follicle to release its egg.

-Stimulates the formation of the corpus luteum, which secretes progesterone.

-Essential for the transition from the follicular to the luteal phase of the estrous cycle.

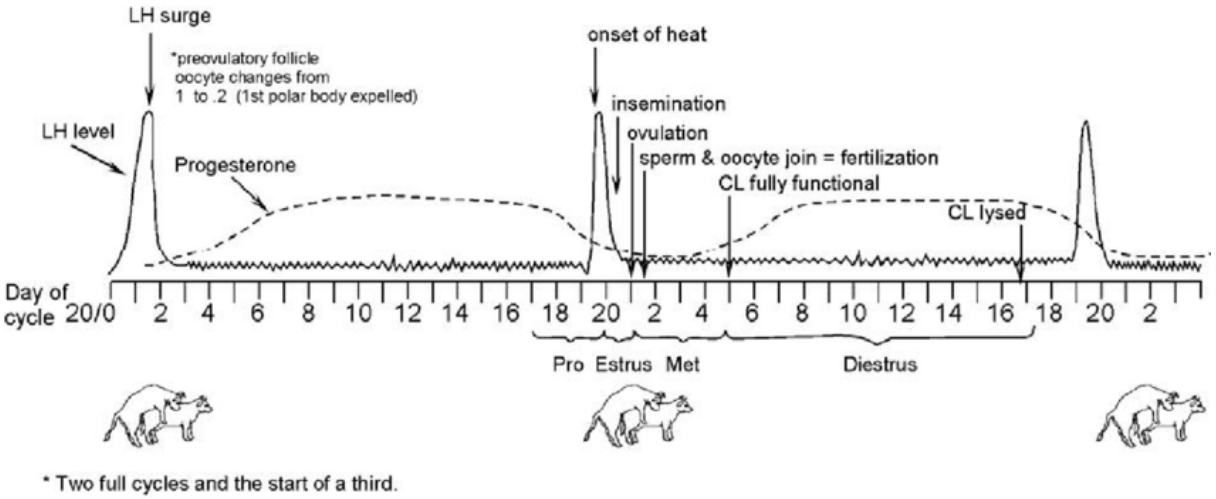
1.1.5. Oxytocin - Synthesized in the hypothalamus and released by the posterior pituitary gland.

Induces uterine contractions during labor.

Stimulates milk let-down during lactation.

1.2 Oestrus cycle

The **oestrous cycle** in cows is a repetitive cycle of physiological changes that prepare the animal for reproduction. It lasts approximately 21 days (ranges from 18 to 24 days) and is divided into four main stages or phases: proestrus, estrus, metestrus, and diestrus. Each phase is characterized by specific hormonal, behavioral, and physiological changes.



* Two full cycles and the start of a third.

1.2.1 Stages/Phases of the Oestrus Cycle in Cows

Stage/Phase	Duration	Hormonal Changes	Characteristics

Stage/Phase	Duration	Hormonal Changes	Characteristics
1. Proestrus	3-4 days	Increase in oestrogen	- The follicle develops on the ovary. - The oestrogen level rises, preparing the uterus for oestrus. - Physical Signs: Slight swelling of the vulva, increased vaginal mucus,
2. Oestrus (Heat)	12-18 hours	Peak oestrogen	-Physical Signs: The cow becomes very receptive to the bull, stands to be mounted, exhibits restlessness, frequent urination, and clear vaginal discharge. - The cow is in heat, and this is the time for mating or artificial insemination.
3. Metestrus	3-5 days	Rapid rise in progesterone	- Ovulation occurs at the end of oestrus (release of the egg). - Progesterone levels begin to rise, preparing the uterus for pregnancy. - The cow may show a brief period of resistance to mounting after oestrus. - Physical Signs: Decreased vaginal discharge, the cow may appear less restless.
4. Dioestrus	10-14 days	High progesterone	- The corpus luteum (CL) forms on the ovary after ovulation. - Progesterone is at its highest level, and prevents further oestrus. - Physical Signs: The cow is not in heat and shows no signs of oestrus behaviour. If the cow is pregnant, the corpus luteum remains active. If not pregnant, the corpus luteum regresses, and the cycle begins again.
5. Anoestrus (optional phase)	Variable (depends on conditions)	Low levels of hormones	- The cow is not cycling due to factors like pregnancy, lactation, stress, or poor nutrition. - The cow is inactive in terms of oestrus, and no reproductive events occur.

1.2.2 Signs of oestrus in cows

Here is a table summarizing the noticeable signs and characteristics of oestrus in cows:
(B= behavioural P=physiological V = visible)

Sign/Characteristic	Description

Sign/Characteristic	Description
Standing Heat(V &B)	The cow stands still and allows herself to be mounted by other cows or bulls (primary sign).
Increased Restlessness(V&B)	Increased walking, pacing, or general activity; often seeks out other cows.
Mounting Behavior (B)	The cow attempts to mount other cows or is mounted by others.
Clear Mucus Discharge (V)	Clear, slippery mucus visible from the vulva, indicating fertility.
Swollen and Reddened Vulva.(P&V)	The vulva appears enlarged and reddish due to increased blood flow.
Frequent Urination (V)	Increased urination, often releasing pheromones to attract bulls.
Increased Vocalization(B)	Bellowing or mooing more frequently as a signal to other cows or bulls.
Chin Resting (V&B)	The cow rests her chin on the back or sides of other cows as part of social interaction.
Sniffing and Licking (V&B)	The cow sniffs or licks the genital area of other cows or allows them to do so.
Decreased Feed Intake(V)	Temporary reduction in feed consumption during heat.
Reduced Milk Production(V)	A slight drop in milk yield during oestrus in lactating cows.
Tail Raising or Wagging(V &B)	The tail is frequently raised or wagged, especially during interactions with other cows or bulls.

1.2.3 Practical methods dairy farmers can adopt to identify cows on heat:

Method	Description	How it Works	Benefits	Best Use Case
Visual Observation	Regularly watching for heat signs such as standing heat, mounting, and clear mucus discharge.	Observe cows at least twice daily, especially during cooler times of the day.	Low cost, effective when consistent.	Small to medium herds with dedicated observers.
Tail Paint or Chalk	Applying paint or chalk on the tailhead that rubs off when mounted.	Mounting activity removes or smears the paint, signaling heat.	Simple, inexpensive, and reliable.	All herd sizes; works well with visual monitoring.
Heat	Devices (e.g., Kamar,	Pressure from	High accuracy,	Medium to large

Method	Description	How it Works	Benefits	Best Use Case
Detection Aids	Estrotect) attached to the cow's back that activate when mounted.	mounting activates the device, indicating heat.	reduces the need for constant observation.	herds.

UNIT 3: SYNCHRONISATION OF OESTRUS AND MATING

EXAMINATION GUIDELINE AND OUTCOME

Define the concept of the synchronisation of oestrus/heat
- Briefly describe the various techniques/methods of synchronisation of oestrus/heat
- Advantages and disadvantages of synchronisation of oestrus
- Describe the basic factors causing sterility and infertility in females (cows)
- Define mating/copulation and ejaculation
- 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

IMPORTANT TERMS AND DEFITIONS	T
the process of using hormonal or management techniques to coordinate the oestrus cycles of a group of female animals so that they come into oestrus (heat) simultaneously or within a controlled timeframe	Oestrus Synchronisation

1 Synchronisation of Oestrus (Heat)

The synchronisation of oestrus is a reproductive management practice in livestock where hormonal treatments are used to induce and synchronise the oestrous cycles of a group of animals, ensuring they all come into heat (oestrus) at the same time ,within a predictable and short timeframe.

1.1 Techniques/methods of synchronisation of oestrus/heat

The synchronization of oestrus in livestock involves several techniques or methods, each using specific hormonal treatments to regulate the reproductive cycle. Here's a brief description of the most common methods:

1.1.1.Injection of Prostaglandin-Based Protocols

Prostaglandin are administered to induce luteolysis (regression of the corpus luteum), leading to the onset of oestrus. It is effective only in animals with a functional corpus luteum. Heat occurs 2–5 days

after treatment. Common Use include single or double injection protocols spaced 11–14 days apart. Example: Estrumate, Lutalyse.

1.1.2 Progesterone-Based Protocols

Progesterone is administered via intravaginal devices (e.g., CIDR or PRID) or oral medication to mimic the luteal phase and suppress heat. Progesterone prevents ovulation while in place. Removal triggers oestrus within 2–3 days. Example: Controlled Internal Drug Release (CIDR) devices.

1.1.3.Injection of GnRH-Based Protocols (Ovulation Synchronization)

Gonadotropin-releasing hormone (GnRH) is used to synchronize ovulation. GnRH induces follicular development and ovulation. Common Use: Fixed-time artificial insemination (FTAI) protocols.

1.1.4. Melengestrol Acetate (MGA) Protocol which is mixed with feed.

An oral progestogen fed to animals for a set period to suppress heat. Progestogen feeding is stopped, allowing synchronized heat to occur. It is more common in beef cattle than dairy.

1.2 Advantages and disadvantages of synchronisation of oestrus

The synchronisation of oestrus is beneficial for improving reproductive efficiency, especially in large-scale operations, but it requires careful management and may not be suitable for all farm systems.

Advantages	Disadvantages
Improved breeding efficiency and more predictable calving	High cost of hormonal treatments
Reduced need for heat detection and labor costs	Requires expertise and veterinary support
Timed artificial insemination (TAI) for better conception rates	Inconsistent results in some cows
Improved fertility management and reduced breeding errors	Potential health risks if not properly managed
Better control of calving intervals	Limited flexibility for spontaneous breeding
Cost-effective in large herds	Reduced natural mating behavior in some systems
Disease control through reduced bull exposure	Dependency on external resources (hormonal treatments, vet support)

1.3 Basic factors causing sterility and infertility in females (cows)

Factor	Description
Genetic Factors	Inherited disorders affecting reproductive organs or hormone production.
Hormonal Imbalances	Anovulation, cystic ovaries, or progesterone deficiencies.
Uterine Infections or Diseases	Endometritis, pyometra, or metritis affecting the uterus.
Ovarian or Uterine Abnormalities	Ovarian tumors, uterine prolapse, or scarring.
Nutritional Factors	Poor or imbalanced nutrition, obesity, or malnutrition.
Environmental and Stress Factors	Heat stress, poor housing, and seasonal effects.
Reproductive Tract Injuries	Trauma or scarring of reproductive organs affecting fertility.
Poor Breeding Management	Improper AI timing, handling of semen, or use of poor bulls.
Age and Reproductive Senescence	Decreased fertility with age or reproductive system failure.
Other Health Conditions	General health issues like lameness or systemic diseases.

1.4 Mating/copulation and ejaculation

1.4.1. Mating (Copulation)

Mating, also referred to as copulation, is the natural process by which two animals come together to reproduce. It involves the physical union of a male and a female, typically through sexual intercourse, during which the male introduces sperm into the female's reproductive tract.

Natural Mating in Cows: Natural mating refers to the reproductive process where the male (bull) and female (cow) engage in mating without the assistance of artificial insemination. In this process, several behaviors and physiological patterns play a role in ensuring successful copulation and fertilization.

1.4.2 Male Sexual Display / Courtship Behavior / Pattern

Before mating, bulls typically engage in courtship behaviors or sexual displays to attract a female and signal their readiness to mate. These behaviors serve to indicate the bull's dominance, fitness, and willingness to breed, as well as to stimulate the female’s receptivity.

Common Courtship Behaviors of Bulls:

- **Sniffing and Nuzzling:** The bull often sniffs the cow’s genital area to detect hormonal cues indicating she is in estrus (heat)

- **Chin Rubbing:** Bulls may rub their chin or neck against the cow's back or head, a behavior often associated with affection and courtship.
- **Flehmen Response:** The bull curls his upper lip and raises his head, often after sniffing the female's urine or genital area, to detect pheromones that signal the female is in heat.
- **Bellowing or Vocalizing**: Bulls may vocalize loudly to announce their presence and attract the attention of a female.
- **Mounting Attempts**: The bull may attempt to mount the cow before actual copulation. This behavior is both an indication of readiness and a way to check for receptivity.

1.4.3 Factors That Regulate Mating Behavior Among Bulls

Several internal and external factors regulate mating behavior in bulls. These include:

a. Hormonal Influence:

Testosterone: Testosterone levels play a crucial role in the development of mating behavior in bulls. This hormone influences libido, aggression, and sexual drive. Estrous Cycle of the Cow: The cow's estrous cycle, particularly when she is in heat (oestrus), strongly influences the bull's mating behavior. Bulls are most active and responsive to females in estrus.

b. Age and Experience:

Mature Bulls: Older, more experienced bulls are generally more effective at detecting cows in heat and initiating mating. They also exhibit more confident and dominant behaviors. Young or Inexperienced Bulls: Bulls that are too young or inexperienced may display less effective courtship or struggle to complete mating.

c. Social Hierarchy and Dominance:

Dominance: Bulls establish a social hierarchy, where dominant bulls often have preferential access to females in estrus. Subordinate bulls may struggle to mate or may only have access to less fertile cows. Aggressive Interactions: During mating season, bulls may engage in fights or displays of aggression to assert dominance and secure mating opportunities.

d. Environmental Factors:

Presence of Other Bulls: The presence of other bulls may cause competition, which can trigger more intense courtship behaviors or fights.

Herd Structure: Bulls tend to be more focused on mating when they are in groups where cows are concentrated, especially during the breeding season.

Health and Nutrition: Adequate nutrition, health, and well-being are essential for a bull to maintain sexual behavior. Poor health or stress can reduce libido and affect mating success.

1.5 The Five Main Stages of Mating / Copulation

Mating or copulation in cattle typically involves five distinct stages, from the initial courtship to the final ejaculation. Each stage is essential for successful reproduction.

Stage 1: Courtship and Sexual Attraction
The bull first approaches the cow and begins courtship behavior, which may include sniffing, licking, and vocalizing to attract the female.Pheromes produced to attract bulls.

Stage 2: Mounting

Once the cow is receptive, the bull mounts her. This stage involves the bull positioning himself behind the cow, with his forelegs placed on her sides for successful copulation.

Stage 3: Intromission/copulation (Penis Insertion)

After successful mounting, the bull inserts his penis into the cow's vagina. This stage is crucial for the transfer of sperm into the female's reproductive tract.

Stage 4: Ejaculation

Ejaculation is the release of sperm and seminal fluid from the bull's testes and accessory glands. This stage involves a series of rhythmic contractions that expel sperm into the cervix, leading to potential fertilization.

Stage 5: Dismounting

After ejaculation, the bull typically dismounts the cow and may retreat or continue to show interest in other females. The cow may exhibit behaviors such as standing still (allowing for a second mating) or walking away.

 **Activity 1.1**

1.1.1 Use given terms to answer questions that follow.

Spermatogenesis	Oogenesis	Vas deferens	Epididymis	testes	ovaries

(a) Primary reproductive organ in male (1)

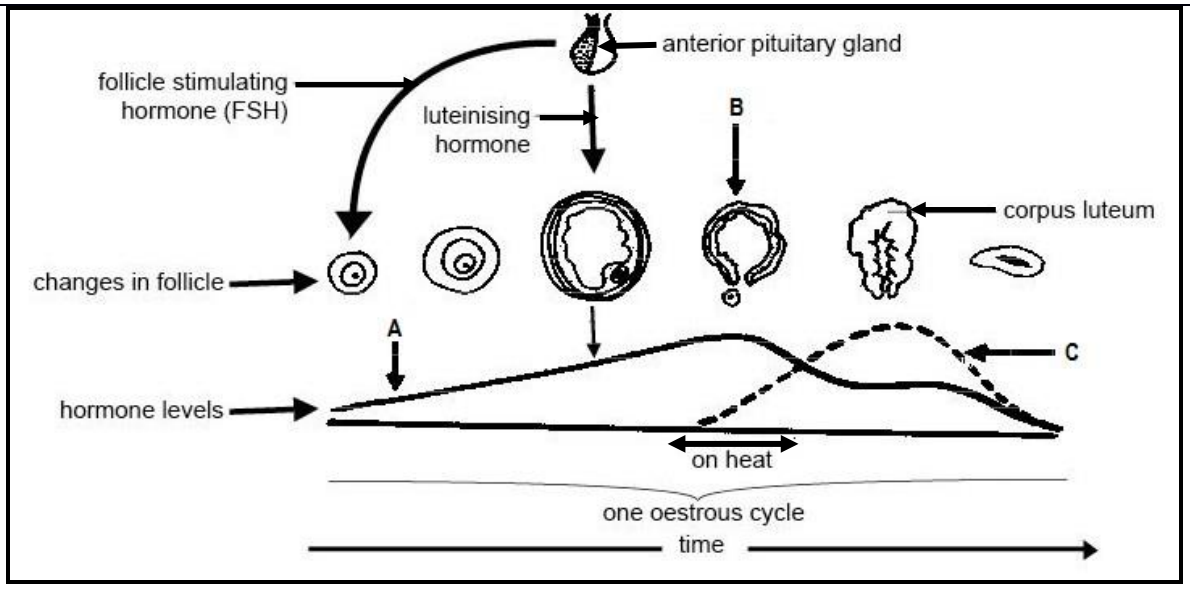
(b) …….. concentrate the spermatozoa in the fluid (1)

(c) Process of gamete formation which initiate before birth (1)

1.1.2 Identify two processes of gamete formation in male and female (1)

1.1.3 Describe both process mentioned in question 2 based on what they produce and where.(2)

1. 2 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.



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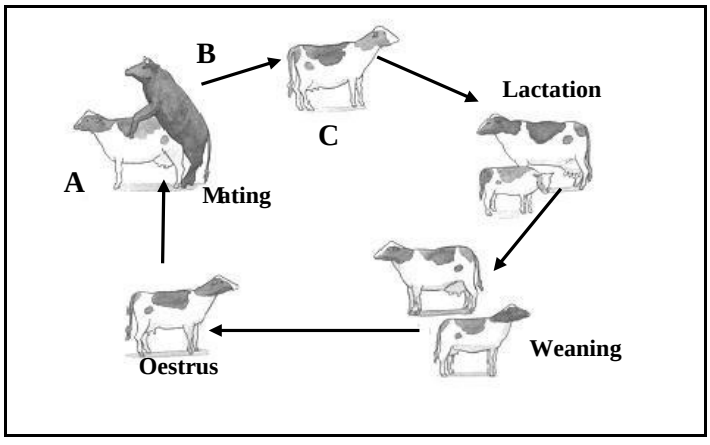
1.2.1 Identify hormone A and hormone C. (2)

1.22 Explain the process at B. (2)

1.2.3 Briefly describe TWO visible signs that the cow will display when hormone A is at its peak. (2)

1.2.4 State the main function of FSH in the schematic representation above. (1)

1.3. The picture below shows the reproductive cycle in cattle.



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

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

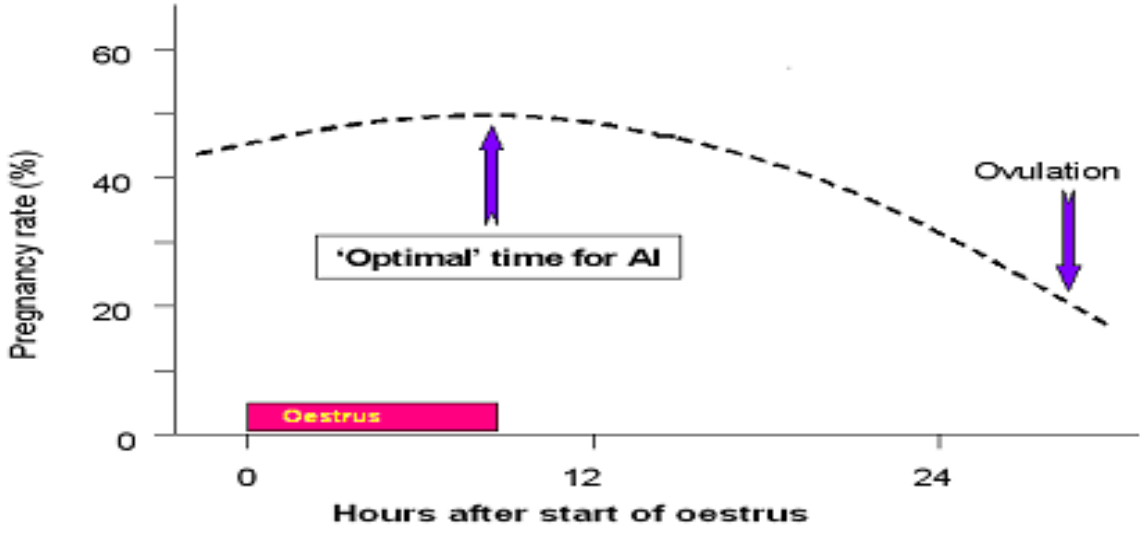
1.3.3 Identify the following reproductive processes:

(a) **C** after successful action by animal **A** and animal **B**

(b) Between **C** and lactation (1)

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

1.3.5 Indicate how the hormone in QUESTION 1.3.4 functions in milk letdown. (1)



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

1.4.2 Give a reason why an inseminator will be able to inseminate the cow between the first hour and 12 hours after the start of oestrus. (1)

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

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

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

1.6

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 to the cervix.
- A cow is sheltered and kept calm.
- Excess faecal matter is removed.

1.6.1 Re-arrange the steps above in the correct order to ensure that the process is carried out with success. (4)

1.6.2 State TWO disadvantages of artificial insemination for the farmer. (2)

UNIT 4: ARTIFICIAL MATING (ARTIFICIAL INSEMINATION, EMBRYO TRANSPLANTATION AND CLONING)
EXAMINATION GUIDELINE AND OUTCOME
• Define artificial insemination • Indicate the main requirements for successful AI • List the advantages and disadvantages of AI • Describe the collecting of semen by using an artificial vagina or electrical stimulation/electro-ejaculator • State the basic requirements for semen collection and storage • Describe the characteristics of good quality semen (semen evaluation) • Describe the dilutants and functions of such dilutants • Identify the correct time for artificial insemination (timing for AI) • Indicate and describe the correct technique for carrying out AI 

IMPORTANT TERMS AND DEFITIONS	
Artificial Insemination (AI) is a reproductive technology in which sperm is manually collected from a male and introduced into the reproductive tract of a female without natural mating.	Artificial Insemination (AI)

1 Artificial insemination

Artificial Insemination (AI) is a reproductive technology that involves the deliberate introduction of sperm into a female's reproductive tract by means other than natural copulation. The sperm used in AI is typically collected from a male (bull, in the case of cows), processed, and stored in liquid or frozen form before being artificially deposited into the female's reproductive system, usually during her optimal fertile period (estrus or heat).

1.1 Requirements for Successful AI

For Artificial Insemination (AI) to be successful, several key factors must be carefully managed and met. These requirements ensure that the sperm is viable, properly introduced into the female's reproductive tract, and can result in successful fertilization. Below are the main requirements for successful AI:

Requirement	**Description**
Proper Timing of Insemination	Insemination should be timed according to the cow's estrus cycle.

Requirement	Description
High-Quality Semen	Semen must be viable, motile, and healthy.
Proper Handling of Semen	Semen must be stored, transported, and thawed under optimal conditions.
Skilled Inseminator	Insemination must be performed by a trained and skilled technician.
Cleanliness and Hygiene	Equipment and environment must be sterile to prevent infections.
Reproductive Health of the Female	The female must have a healthy reproductive tract and good physical condition.
Suitable Environment and Stress Management	Stress-free environment for both bull and cow to ensure optimal conditions.
Good Record Keeping and Monitoring	Accurate records of estrus cycles and insemination timing are necessary.
Sufficient Semen Quantity and Genetic Compatibility	Adequate sperm quantity and selection of genetically superior bulls.
Accurate Identification of Females in Estrus	Reliable detection of estrus signs to ensure correct insemination timing.

1.2 Advantage and disadvantages of AI

Advantages of AI	Disadvantages of AI
Improved Genetics: AI allows farmers to use semen from superior bulls,	Labor-Intensive: AI requires trained technicians and careful timing,
Disease Control: AI reduces the risk of transmitting sexually transmitted diseases (STDs) between animals, as there is no direct physical contact	Costs: Initial costs of semen, AI equipment, and training can be high, especially for small-scale farms.
AI allows for the use of high-quality semen, even from bulls in different locations, enabling efficient breeding without the need for physical presence of bulls.	:Accurate estrus detection and proper timing are crucial; failure to detect estrus accurately can lead to failed insemination.
Prevents Inbreeding: AI allows the introduction of new genetic material into the herd, preventing inbreeding	If the semen is improperly handled, the chances of successful fertilization can be reduced.
No Need for a Bull: Farmers do not need to keep a bull,	Animal Health: If the cow has reproductive

Advantages of AI	Disadvantages of AI
saving space, feed costs, and the risk of injury to other animals or farm workers.	health issues (e.g., infections, uterine problems), AI may not be successful.
Improved Record Keeping: AI can be part of a structured breeding program, allowing for better records of breeding history, genetics, and performance.	Management Complexity: Requires meticulous record-keeping, monitoring of estrus cycles, and precise handling of semen.
Access to Superior Bulls: AI makes it easier to access the semen of elite bulls, including those from different regions or countries.	Technical Skill Requirement: AI requires skilled technicians to perform the procedure, making it harder for untrained individuals to successfully inseminate cows.
Genetic Progress: AI accelerates genetic improvements in herds by facilitating the use of bulls with superior traits.	Risk of Improper Handling: Mishandling of semen or improper storage conditions (e.g., thawing issues) can reduce fertility rates.
	Failure to Achieve Pregnancy: AI does not always result in pregnancy, and repeated attempts may be required, which can be costly.

UNIT 5: EMBRYO TRANSPLANTATION/ TRANSFER (ET)

EXAMINATION GUIDELINE AND OUTCOME

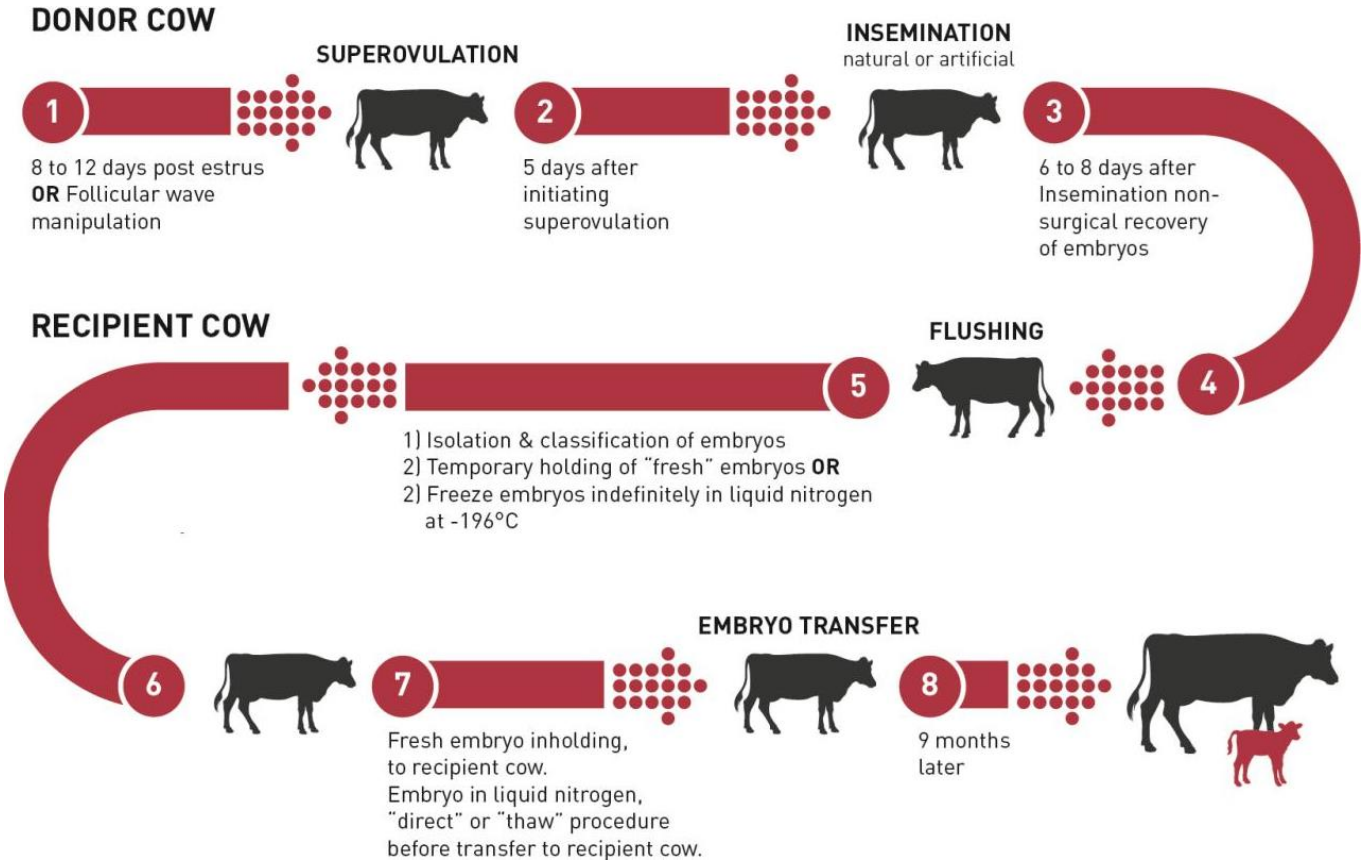
Identify and define embryo transplantation/transfer (ET), super ovulation, embryo flushing/harvesting, donor cows, recipient cows.

- Describe the aims/purposes of ET and embryo flushing/harvesting
- List the advantages and disadvantages of ET.

IMPORTANT TERMS AND DEFITIONS	T
Transfer of an in vitro fertilised egg	Embryo transfer
Cow of superior genetic merit	Doner cow
Usually of inferior genetic merit also known as the surrogate mother	Recipient cow
Removal or viable embryos from the uterus of a doner cow	Embryo flushing
Treating a doner cow with hormone to allow for the production of many mature ova at once	Superovulation

1 Embryo transplantation/ transfer (ET)

Embryo Transfer (ET): Embryo transfer is a reproductive biotechnology where embryos from a genetically superior female (donor) are collected and implanted into the reproductive tract of an inferior female (recipient). The recipient carries and births the offspring.



Superovulation:
Superovulation is the stimulation of the donor cow to produce multiple egg cells (oocytes) during a single estrous cycle. This is achieved using hormonal treatments like follicle-stimulating hormone (FSH).

Embryo Flushing/Harvesting:
This is the process of collecting embryos from the uterus of a donor cow after fertilization. A non-surgical catheter is inserted into the uterus, and a flushing medium is used to retrieve the embryos.

Donor Cows:
Donor cows are genetically superior females selected for their high milk production, superior growth traits, or other desirable characteristics. These cows produce superior embryos for transfer.

Recipient Cows:
Recipient cows are healthy females with normal reproductive cycles used to carry embryos from donor cows. They serve as surrogate mothers but do not contribute genetically to the offspring.

1.1 Aims and Purposes of ET

Genetic Improvement:
ET allows for the rapid multiplication of offspring from genetically superior females

Preservation of Genetics:
It helps preserve the genetics of endangered breeds or high-performing animals.

Global Exchange of Genetics:
Embryos are easier and safer to transport internationally than live animals, reducing biosecurity risks.

Efficient Use of Superior Females:
Superior females can produce more offspring through ET than by natural reproduction, which typically produces only one calf per year.

Description of Embryo Flushing/Harvesting

Collecting Multiple Embryos: Flushing allows the collection of multiple embryos from a single super ovulated donor cow in one cycle.

Embryo flushing ensures that fertilized embryos are collected and preserved for transfer, storage, or sale.Flushing enables the examination and grading of embryos to ensure only viable ones are used for transfer.

1.2 Advantages of Embryo Transfer (ET)

Increased Reproductive Efficiency: A single donor can produce multiple offspring per year.

Genetic Diversity: Superior genetics can be distributed across herds, improving herd productivity and quality.

Disease Control: Embryos are less likely to transmit diseases compared to live animals.

Conservation of Valuable Genetics: Enables the preservation and propagation of elite or endangered breeds.

Economic Benefits: High-value embryos can be sold, providing an income source for breeders.

Crossbreeding Opportunities: Combines desirable traits from multiple breeds efficiently.

1.3 Disadvantages of Embryo Transfer (ET)

High Costs: The procedure involves significant expense for hormones, equipment, and skilled labor.

Technical Expertise Required: The success of ET depends on the expertise of veterinarians and technicians.

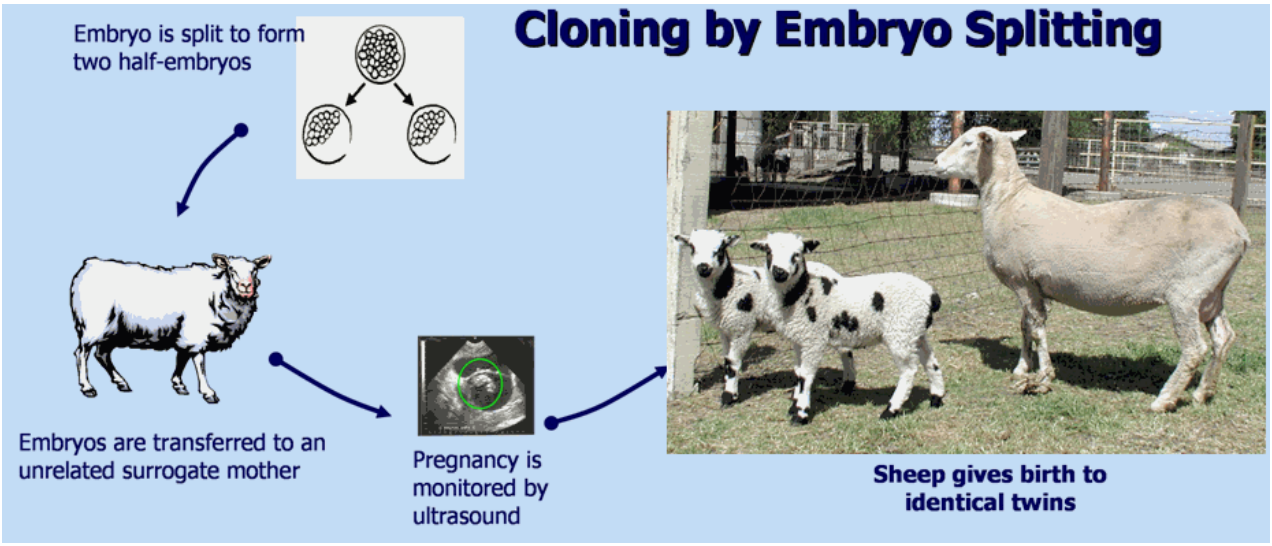
Variable Success Rates: Pregnancy rates vary and may not always be high, depending on factors like embryo quality and recipient health.

Stress to Donor Cows: Repeated superovulation and embryo flushing can stress donor cows.

Ethical Concerns: Some may question the ethics of manipulating reproduction for economic gain.

2 Nuclear transfer (Cloning)

Nuclear transfer is a reproductive biotechnology technique in which the nucleus of a somatic cell from a donor (a body cell other than a reproductive cell) is transferred into an enucleated egg cell (an egg cell whose nucleus has been removed). This process results in the creation of a genetically identical organism, known as a clone.



2.1 Aims/purposes of animal cloning

- To produce large number of genetically identical animals
- To produce offspring from high quality animals
- To preserve and extend proven superior genetics
- To achieve high quality meat and dairy products
- To increase the number of endangered species

2.2 Two types of cloning

Reproductive cloning focuses on creating a new organism identical to the donor, with applications in agriculture, conservation, and potentially humans.

Therapeutic cloning aims to generate stem cells for medical research and treatment, prioritizing the development of therapies over producing a living organism.

2.3 Advantages and disadvantages of cloning

Advantages: Cloning offers transformative opportunities in agriculture, medicine, and conservation, enabling genetic preservation, consistent production, and medical breakthroughs.
Disadvantages: Ethical concerns, inefficiencies, health issues, and high costs challenge its widespread application and acceptance.

3 Fertilisation and pregnancy

3.1 Fertilisation

Fertilisation is the process by which a male gamete (sperm cell) and a female gamete (egg or ovum) fuse to form a zygote.

3.2 Pregnancy/Gestation

Pregnancy or gestation is the period during which an embryo or fetus develops inside the female's uterus after fertilisation.

3.3. Freemartins

A freemartin is a female mammal, usually a cow, that is sterile due to exposure to male hormones during development in the uterus.

3.4. Placenta

The placenta is an organ that develops in the uterus during pregnancy in most mammals. It facilitates the exchange of nutrients, gases, and waste products between the mother and the developing fetus through the umbilical cord.

4 Pregnancy/Gestation

4.1 Overview

The process of fertilisation involves the fusion of a male sperm cell with a female egg cell (ovum) to form a zygote.

Here's an overview of the fertilisation process:

1. Ovulation

At the beginning of the menstrual cycle, an ovum (egg cell) matures within a follicle in the ovary. When the egg cell reaches maturity, it is released from the ovary in a process called ovulation. The egg is then captured by the funnel- shaped infundibulum in the fallopian tube.

2. Sperm Transport

During sexual intercourse, semen containing sperms is ejaculated into the female's vagina. From there, sperms move through the cervix into the uterus and then into the fallopian tubes, where they may encounter the egg cell in the ampula.

3. Penetration of the Egg cell

When sperms reach the egg cell, they must penetrate its protective outer layer, called the zona pellucida, using enzyme(hyaluronidase) released from the acrosome (a cap-like structure on the head of the sperm). Several sperms may attempt to penetrate the egg cell, but usually, only one sperm will successfully enter the egg cell.

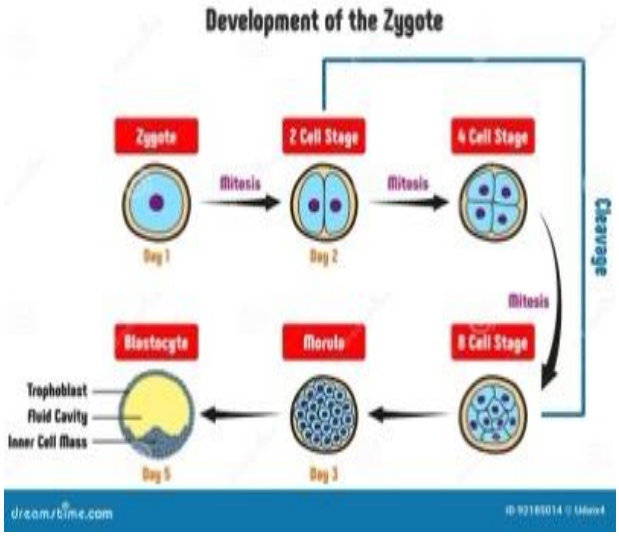
4. Fusion of Sperm and Egg cell

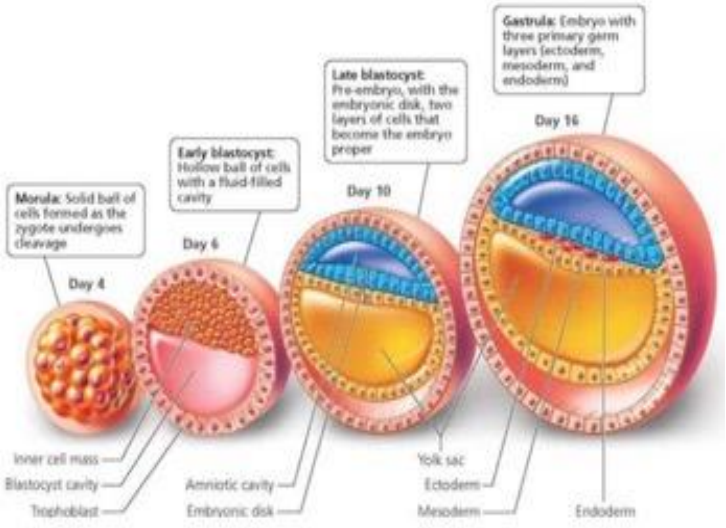
Once a sperm successfully penetrates the egg cell, the egg’s membrane undergoes changes to prevent any other sperm from entering. The sperm's nucleus, which contains half of the genetic material

(haploid), fuses with the egg's nucleus, also containing half of the genetic material. These fusion forms a single, diploid zygote with a complete set of chromosomes (46 in humans).

5. Zygote Formation and Early Development

After fertilisation, the zygote begins to divide through a process called mitosis. The first few cell divisions result in a cluster of cells called a **morula**, which later develops into a **blastocyst**. The blastocyst will implant itself into the lining of the uterus to begin the process of embryonic development.





This marks the start of pregnancy or gestation, and the fertilised egg (now called an embryo) will continue developing into a fetus.

4.2 The formation of multiple births and freemartins

The formation of multiple births and freemartins involves unique biological processes. Here's an explanation of each:

1. Formation of Multiple Births (Twins)

Multiple births occur when more than one offspring is produced in a single pregnancy. There are two main types of multiple births: dizygotic (fraternal) twins and monozygotic (identical) twins.

Dizygotic (Fraternal) Twins:

Formation: These twins arise from the fertilisation of two separate eggs by two separate sperm cells. Each egg develops into an individual embryo, and both embryos implant in the uterus.

Genetics: Fraternal twins are genetically distinct from each other, like any other siblings. They share 50% of their genes.Likelihood: Fraternal twins are more common and can occur naturally or with assisted reproductive techniques (e.g., fertility treatments).

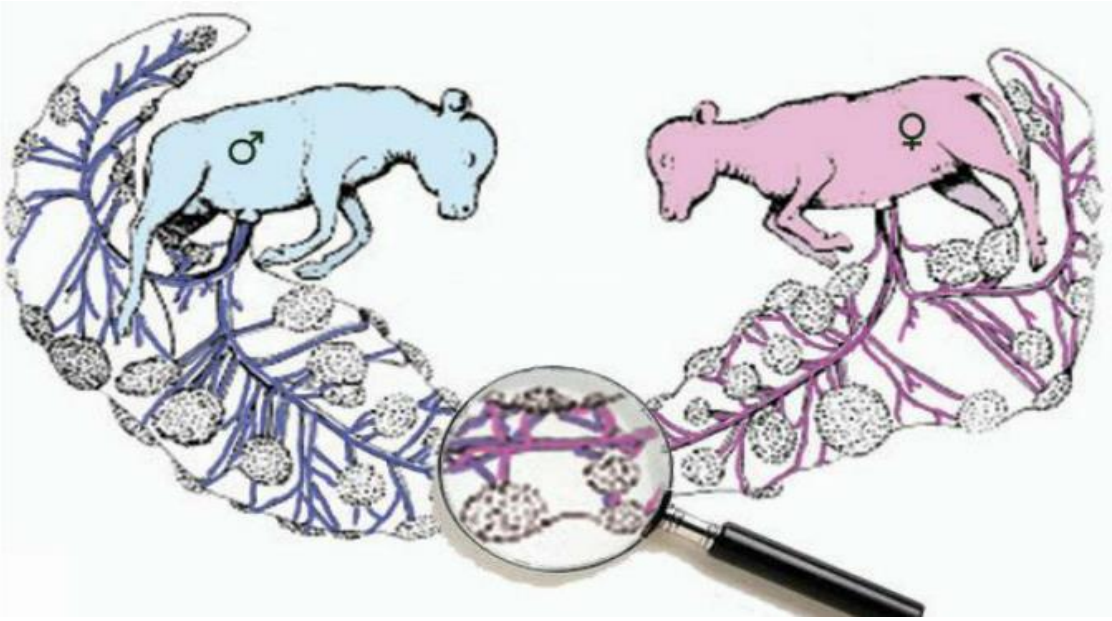
Monozygotic (Identical) Twins:

Formation: These twins arise from a single fertilised egg (zygote) that, at some point during its early cell division, splits into two embryos. As a result, both embryos are genetically identical and share the same genetic material.

Genetics: Monozygotic twins have the same genetic makeup, making them genetically identical.Likelihood: Identical twins are less common than fraternal twins and are typically a random occurrence.

2. Freemartins:

A freemartin is a specific type of female twin that is usually born to a pair of heterosexual (opposite-sex) twins. A **Freemartin** is a female heifer that is born a twin with a bull and is born with reproductive tract deformities and in most all cases is infertile.



4.3 The phases/stages of pregnancy in cows:

Stage	Time Period	Key Events	Fetal Development
1. Embryonic Development	Weeks 1–8	- Fertilisation and implantation. - Formation of the placenta. - Hormonal changes to maintain pregnancy.	- Zygote divides into embryo. - Major organ systems start to form. - Heart begins to beat.
2. Fetal Development	Weeks 9–24	- Rapid fetal growth. - Organ systems continue to develop.	- The fetus develops more recognizable features. - Internal organs mature and

Stage	Time Period	Key Events	Fetal Development
		- Increased size and development of limbs, facial features.	become functional.
3. Final Development and Preparturient Period	Weeks 25–40	- Rapid growth continues. - Fetal organs mature (lungs, digestive system). - Positioning of the fetus for birth.	- Fetus gains weight, develops fat. - Fully formed, capable of survival outside the womb.

4.4 Causes of abortion

Category	Cause	Description
Infectious Causes	Bacterial Infections	- Brucellosis (Brucella bacteria) in cattle, goats, and sheep. - Leptospirosis (Leptospira bacteria) in cattle and swine. - Listeriosis (Listeria monocytogenes) in cattle, sheep, and goats.
	Viral Infections	- Bovine Virus Diarrhea Virus (BVDV) in cattle. - Rinderpest in cattle. - Canine Herpesvirus in dogs.
	Parasitic Infections	- Toxoplasmosis in sheep. - Neospora in cattle.
Non-Infectious Causes	Nutritional Deficiencies	- Lack of essential vitamins and minerals (e.g., vitamin A, selenium, iodine) can cause developmental issues leading to abortion.
	Toxins	- Exposure to mycotoxins in contaminated feed. - Toxic plants (e.g., Ergot, Lupine).
	Trauma or Injury	- Physical trauma or injury to the abdomen or reproductive organs.
	Environmental Stress	- Extreme heat stress, cold stress, or sudden environmental changes.
Physiological Causes	Hormonal Imbalances	- Low progesterone or excessive cortisol levels may lead to abortion.
	Genetic Factors	- Chromosomal abnormalities in the fetus.

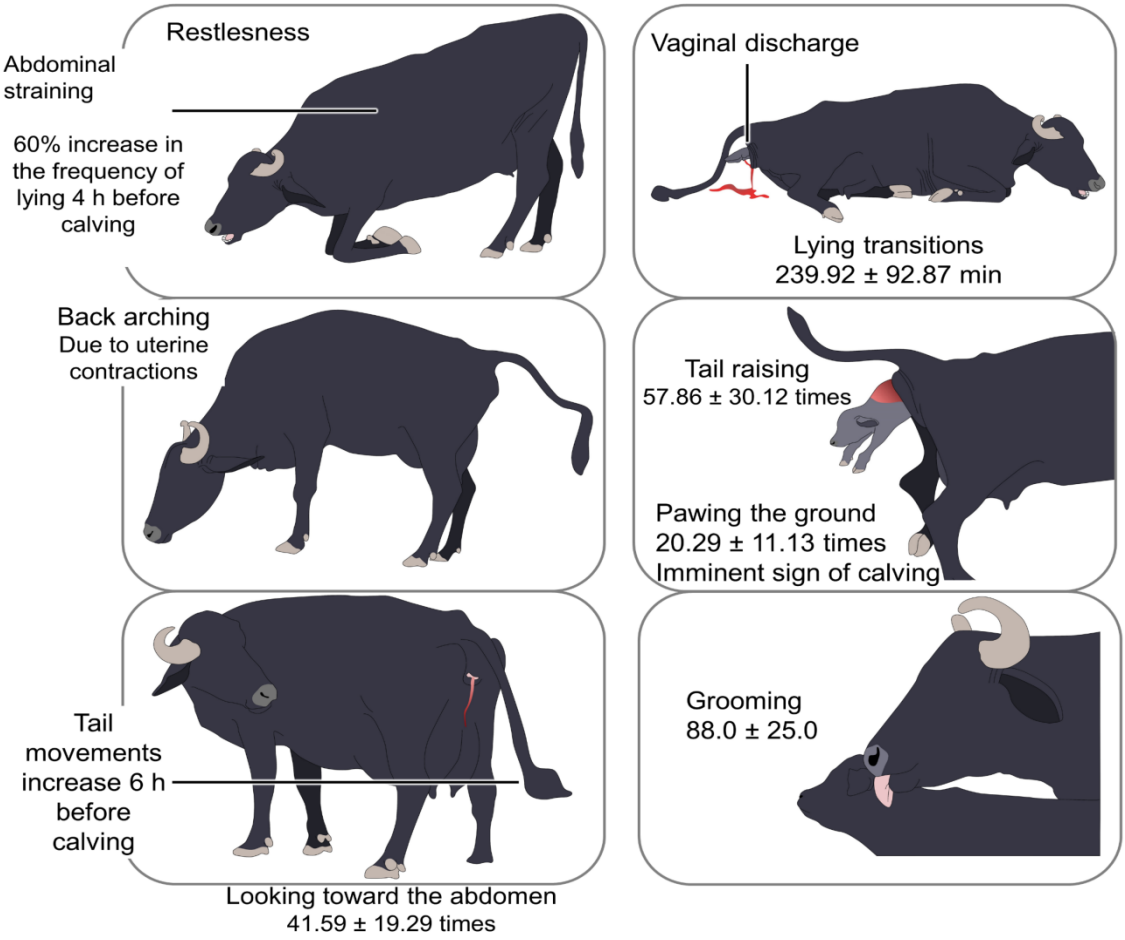
Category	Cause	Description
		- Genetic issues causing miscarriage.
	Age and Reproductive History	- Older animals or those with previous reproductive issues are at higher risk.
	Placental Issues	- Placental insufficiency or infection affecting nutrient supply to the fetus.
Miscellaneous Causes	Inbreeding	- Genetic problems from inbreeding leading to fetal abnormalities.
	Artificial Insemination Issues	- Improper handling or use of semen during artificial insemination (AI) leading to pregnancy failure.

4.5 Birth/Parturition and dystocia

Parturition is the process of giving birth, which involves the series of events that lead to the delivery of the offspring from the mother's body. In mammals, parturition marks the end of pregnancy and the beginning of the newborn's life outside the mother's womb

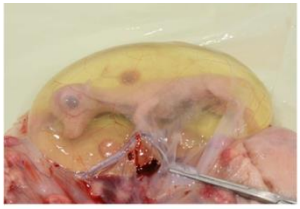
Dystocia refers to a difficult or abnormal labor or delivery. It occurs when there are complications that prevent the normal passage of the fetus through the birth canal. Dystocia can result from various factors affecting the mother, fetus, or both,

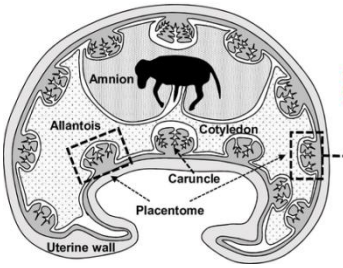
4.6 Signs/Characteristics of a cow approaching parturition

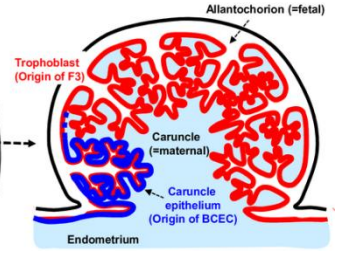


4.7 The layers covering the foetus

Amniotic Sac: Protection, cushioning, temperature regulation, and hydration.
Chorion: Nutrient and gas exchange, placenta formation, and protection.
Allantois: Waste excretion, blood vessel development, and nutrient/gas exchange.
Umbilical Cord: Nutrient, oxygen, and waste transport between the fetus and placenta.
These layers and their respective functions ensure that the fetus is adequately supported, nourished, and protected during gestation, which is critical for healthy development.





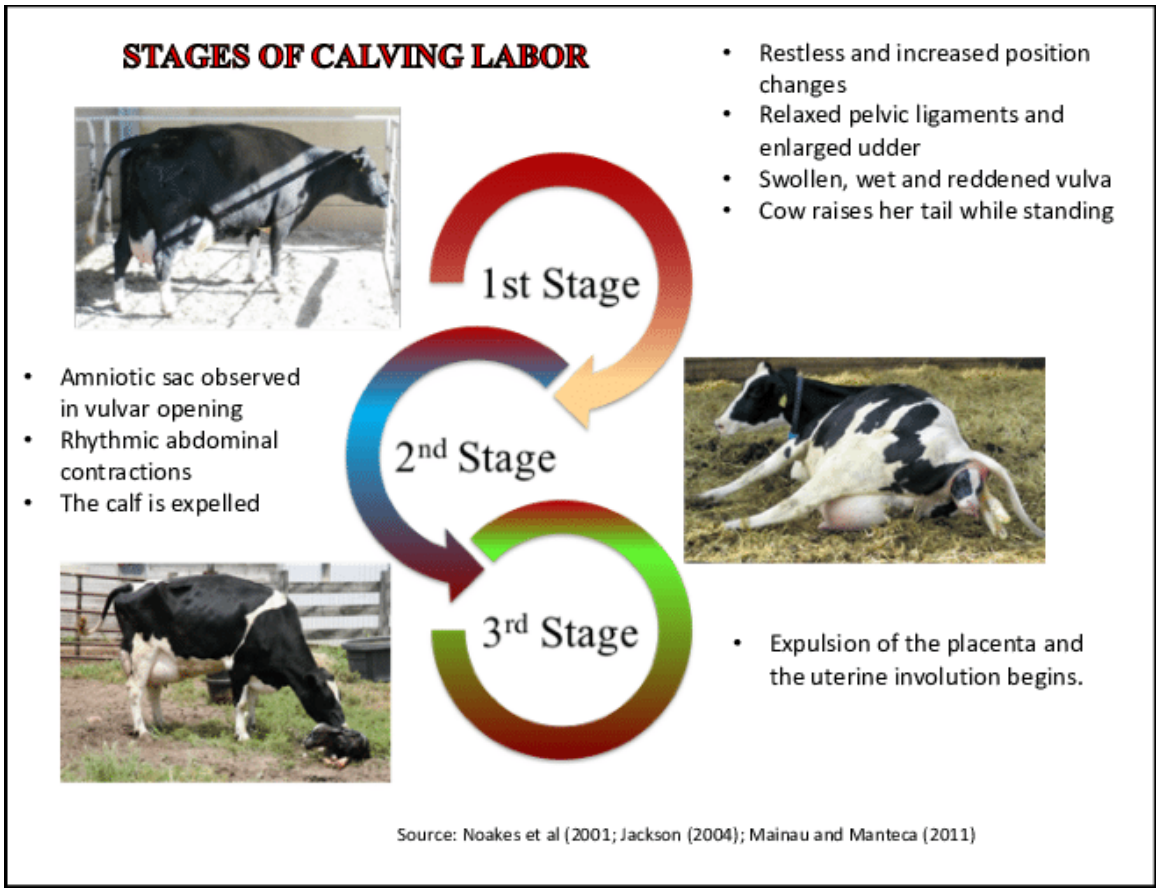


4.8 Stages/phases of parturition

· Stage 1 (Preparatory): Cervical dilation, contractions, restlessness, and isolation.

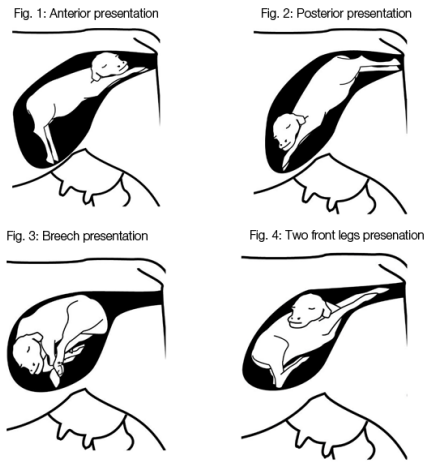
· Stage 2 (Expulsion of Fetus): Active labor, strong contractions, calf delivery.

· Stage 3 (Expulsion of Placenta): Afterbirth is expelled, completing the birth process.



4.9 Correct birth positions of a calf in the uterus

The ideal and Correct Birth Positions:
Normal Anterior Presentation: Head-first with both front legs extended (ideal position).
Normal Posterior Presentation with Extended Hind Legs: Tail-first with both hind legs extended.
Both of these positions allow for the smoothest delivery. If the calf is not in one of these positions, it may lead to complications requiring intervention by a veterinarian or experienced handler.



4.10 Common Conditions Interfering with Parturition:
Dystocia: General term for difficult labor.

Fetal Malpresentation: Abnormal positioning of the fetus.
Fetal Macrosomia: Large calf causing difficulty during delivery.
Pelvic Abnormalities: Structural issues in the cow's pelvis.
Weak Uterine Contractions: Insufficient contractions to deliver the fetus.
Uterine Torsion: Twisting of the uterus, causing obstructed birth.
Retained Placenta: Failure of the placenta to be expelled after birth.
Hydrops: Fluid accumulation in the uterus causing difficulty.
Infection: Bacterial infections affecting labor progress.
Multiple Births: Overcrowding of the uterus due to more than one fetus.
Cervical Incompetence: Failure of the cervix to dilate properly

4.11 Factors Causing Retention of the Placenta in Cows:
Maternal Factors:
Uterine infections (Endometritis)
Weak uterine contractions
Hormonal imbalances (oxytocin or prostaglandin deficiency)
Uterine atony
Aging and poor postpartum health
Fetal Factors:
Abnormal placental development
Fetal macrosomia (large calf)
Management-Related Factors:
Poor calving management
Inadequate nutrition
Stress and environmental factors
Other Factors:
Prolonged or difficult labor (dystocia)
Multiple births (twins or triplets)
Retaining the placenta can lead to serious health risks for the cow, such as infection, uterine inflammation, and potential infertility. Early recognition and prompt treatment of retained placenta are crucial to minimize these risks.

4.12 Milk production/ Lactation

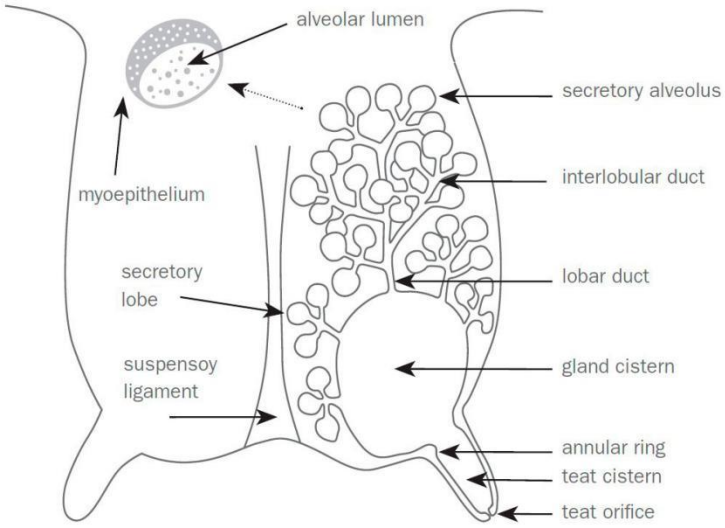
The lactation, dry period and milk ejection

· **Lactation:** The continuous production and secretion of milk, initiated after calving, controlled by hormones.

· **Dry Period:** The resting phase between lactation cycles, crucial for udder health and recovery.

· **Milk Ejection:** The release of milk from the mammary glands triggered by hormonal action, allowing for milking or suckling.

4.13 The structure of the udder of a cow (functions)

· **Teats**: The external part of the udder that allows milk to be released. · **Mammary Glands (Alveoli)**: Milk-producing cells that secrete milk. · **Udder Cistern and Milk Ducts:** Storage and transport system for milk. · **Lobules**: Groupings of alveoli that facilitate milk production. · **Ligaments:** Provide support and structure to the udder. · **Blood Vessels:** Deliver nutrients and remove waste from the udder.	

4.13.1 Milk ejection/milk let down process and hormones involved

The milk ejection process is a hormonal mechanism primarily driven by oxytocin, ensuring that milk produced by the cow is efficiently transported from the mammary glands to the teats for feeding or commercial purposes.

· Stimulus (e.g., suckling, milking) → Sensory Nerves → Hypothalamus

· Hypothalamus signals the posterior pituitary to release oxytocin into the bloodstream.

· Oxytocin acts on the myoepithelial cells, causing them to contract and expel milk from the alveoli into the ducts and cisterns.

· Milk flows from the milk ducts into the teat cistern and is available for suckling or milking.

· Once stimulation stops, oxytocin levels drop, and the milk ejection process concludes.

4.13.2 Colostrum

· Provides essential nutrients for growth and development (proteins, fats, vitamins, and minerals).

· Boosts immunity by providing antibodies (immunoglobulins) to protect the calf against diseases.

· Promotes gut development and helps establish a healthy digestive system.

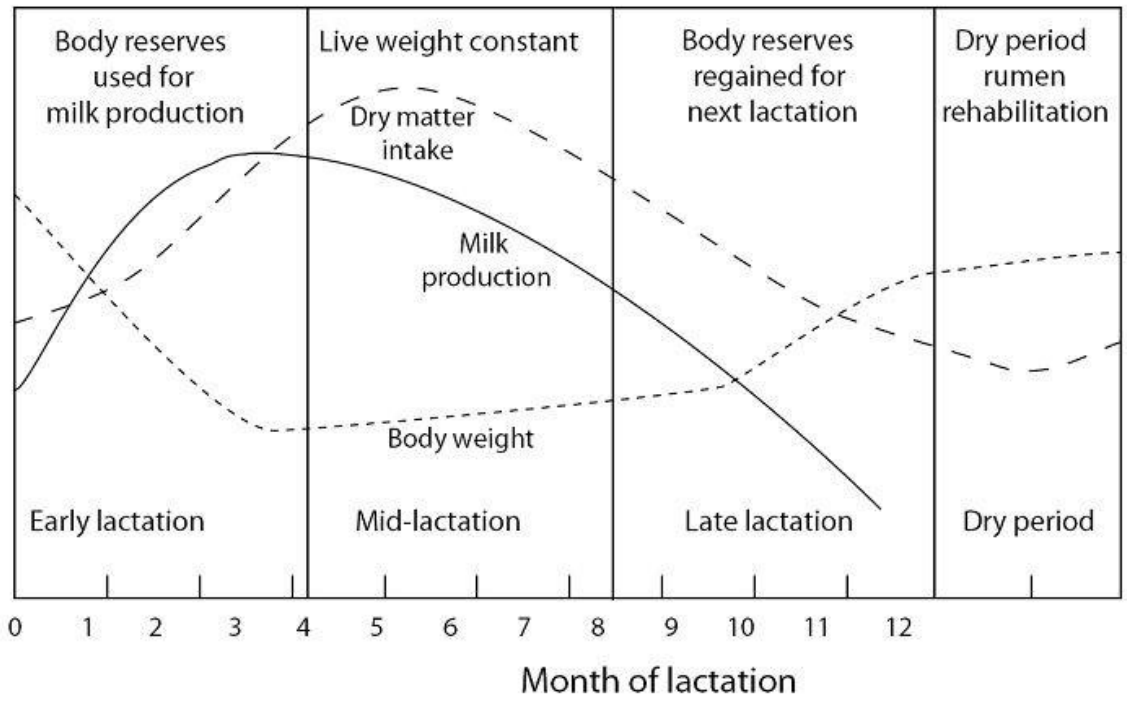
· Provides energy for early physical activity and helps maintain body temperature.

· Supports growth factors that aid in tissue development and maturation.

· Stimulates early feeding behavior, ensuring the calf begins to nurse promptly.

4.13.4 lactation curve and lactation cycle (period)

Understanding the lactation curve and lactation cycle helps farmers and dairy producers optimize milk production, manage cow health, and plan breeding and calving schedules effectively. Proper management during each stage of the lactation cycle is essential for maintaining high productivity and cow welfare.



· Lactation Cycle: Comprises the dry period, early lactation, peak lactation, mid-lactation, and late lactation. The cycle lasts around 305 days, with a 60-day dry period.

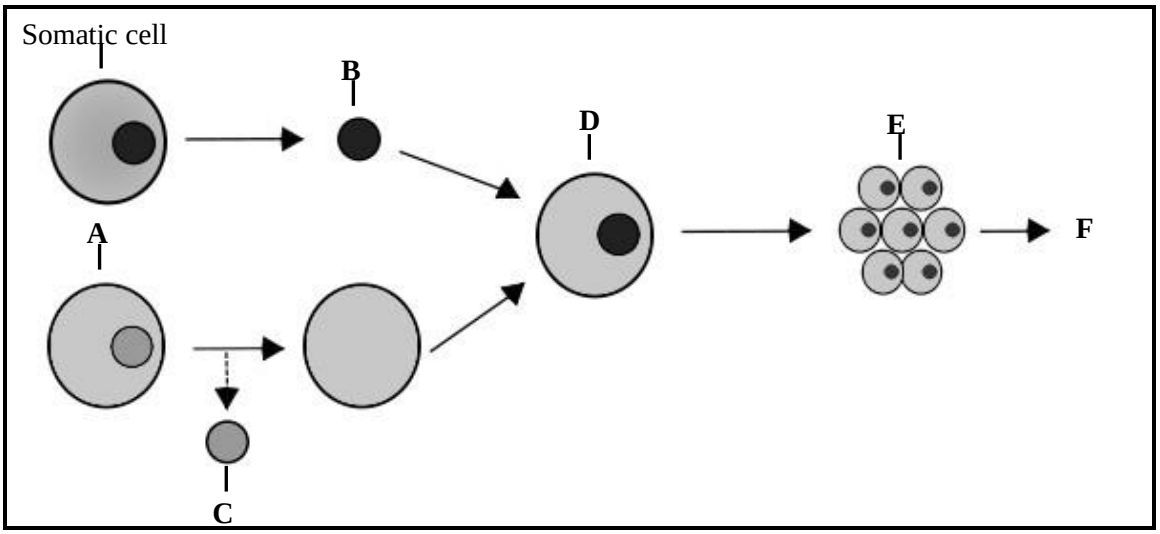
· Lactation Curve: A graph that shows milk production from the time of calving until the dry period. Shows a bell-shaped curve with an increase in milk yield, a peak at 60–90 days, and a decline as the cow approaches the end of the cycle.

· Factors Impacting Both: Genetics, nutrition, health, and management practices all influence the lactation curve and overall performance during the lactation cycle.

Activity 1.2

Question 1

1.The diagram below shows a process generally used in the reproduction of farm animals.



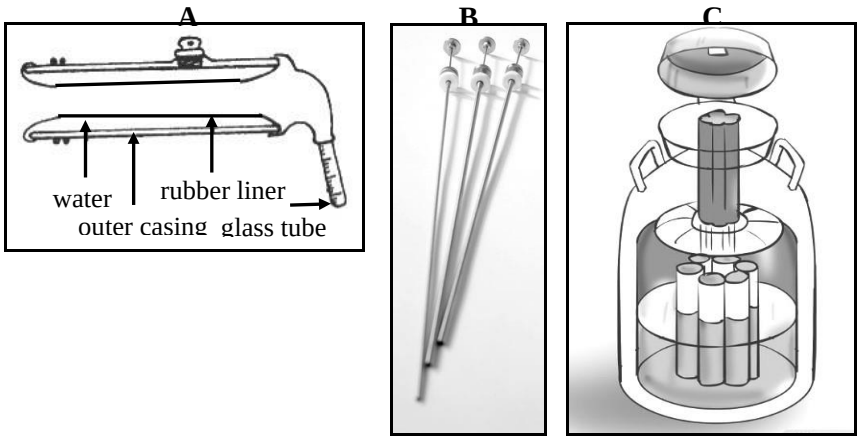
1.2 Identify the process illustrated in the diagram above. (1)

1.2 Identify **A**, **B** and **D** in the diagram above. (3)

1.3 Name the TWO different types of processes in the diagram above. (2)

Question 2

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



2.1 Identify apparatus A, B and C above (3)

2.2 State the main function of apparatus **A**, **B** and **C**. (3)

2.3 Name TWO basic requirements for the collection of semen from bulls. (2)

Question 3 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)

3.1 Identify the process above. (1)

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

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

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

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

Question 5 Problems are usually experienced by heifers that are giving birth for the first time.

5.1 State TWO behavioural signs of an animal that is about to give birth. (2)

5.2 Name TWO causes of problems during birth in heifers. (2)

Question 6 State the importance of EACH of the aspects below in embryo transfer:

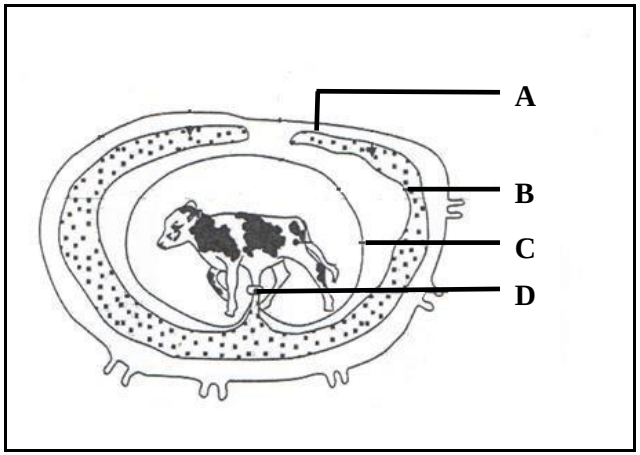
6.1 Superovulation (1)

6.2 Embryo flushing (1)

6.3 Donor cow (1)

6.4 Recipient cow (1)

Question 4. The diagram below shows the layers covering the foetus during pregnancy.



4.1 Name the stage of pregnancy in the diagram above. (1)

4.2 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)

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 • inexperience • Exhaustion:	• Malnutrition: • Disease: • Old age

2. Impotence (inability to copulate)

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

3. Sterility

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

BULL

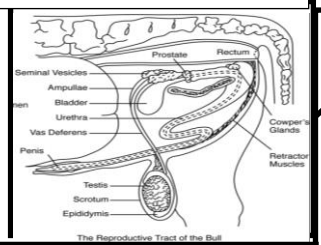
1.Testes (primary)
- Produce sperms
- Produce testosterone

2. **Epididymis**
- Storage, Maturity, Transportation of sperms

3. **Vas deferens**
- Transports sperms

4. **Urethra**
- Transports semen & urine

5. **Penis**



The Reproductive Tract of the Bull

Bull & Cow

COW

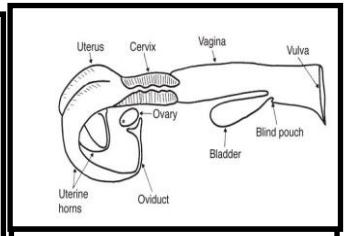
1.**Ovaries** (primary)
- Produces ova

2. Oviducts (fallopian tubes)
- Transports ova
- Site of fertilisation

3. Uterus
- development of the foetus

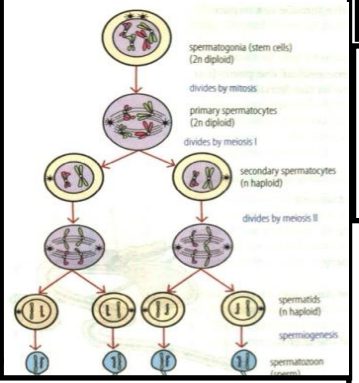
4.Cervix
- barrier during pregnancy
- mucus/ thick plug that blocks bacteria

5.Vagina – for copulation; birth canal



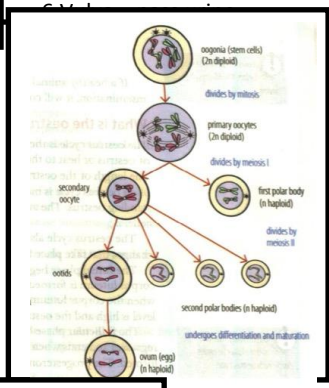
Definition of oestrus cycle
Hormonally controlled recurring periods of oestrus alternating with sexual rest

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



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 ✓



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 decreas

Stages of Oestrus cycle

1. **Pro-oestrus**
2-3 days - FSH

2. **Oestus**
18 hrs - oestrogen

3. **Met-oestrus**
3 days – LH
CL - Progesterone

4. **Di-oestrus**
15 days
Progesterone
and later

Synchronisation of oestrus

-Manipulation of oestrus cycle of cows to come to oestrus same time

Methods & Hormones
1. Inject with Prostaglandin
2. Inject with Progestin
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

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.

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
- Stimulate secretion of FSH

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.

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 recipients.

ADVANTAGES OF E T

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

DISADVANTAGES OF E T

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

Nucleur 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.

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

2.EMBRYO TRANSFER

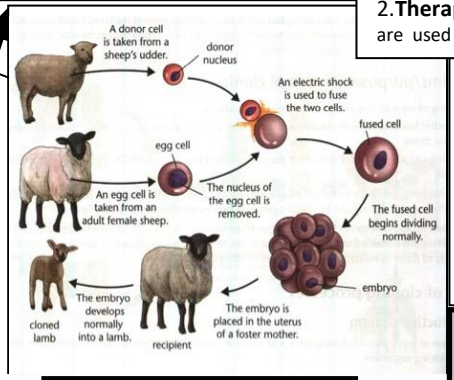
ADVANTAGES OF CLONING

- 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

3.NUCLEAR TRANSFER



Types of cloning

1.**Reproductive cloning** – embryo implanted in uterus to produce offspring (exact copy of donor)
2.**Therapeautic 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.

REPRODUCTIVE TECHNIQUES

1.ARTIFICIAL INSEMINATION

Methods to collect semen

- Artificial vagina
- Electrical stimulator

Semen evaluation
Macroscopic
1.Colour, 2. Density and 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 protects sperms from cold shock.
- Nutrients provide energy for the sperm.
- Antibiotics protect the sperm from bacterial growth.
- Glycerol protects the sperm from freezing
- Dilutants increase the volume

Requirements of AI

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

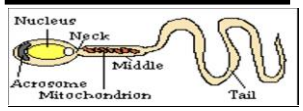
Advantages of AI

- 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



, 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 fusion is known as **fertilisation**.

PARTURITION

TWO causes of Distocia /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

GESTATION

IMPORTANT TERMS

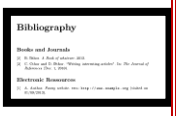
Pregnancy/gestation: This is the period during which the embryo develops.
Freemartin: A sterile female calf born co·twin to a bull, because the blood supply of the two foetuses becomes mixed, hampering the development of the female sex organs.
Placenta: The placenta forms the connection between the mother 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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