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Training and Consultancy
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Province of the
EASTERN CAPE
EDUCATION

AGRICULTURAL SCIENCES

GRADE 12

2024

LAST PUSH

TEACHER AND LEARNER CONTENT MANUAL

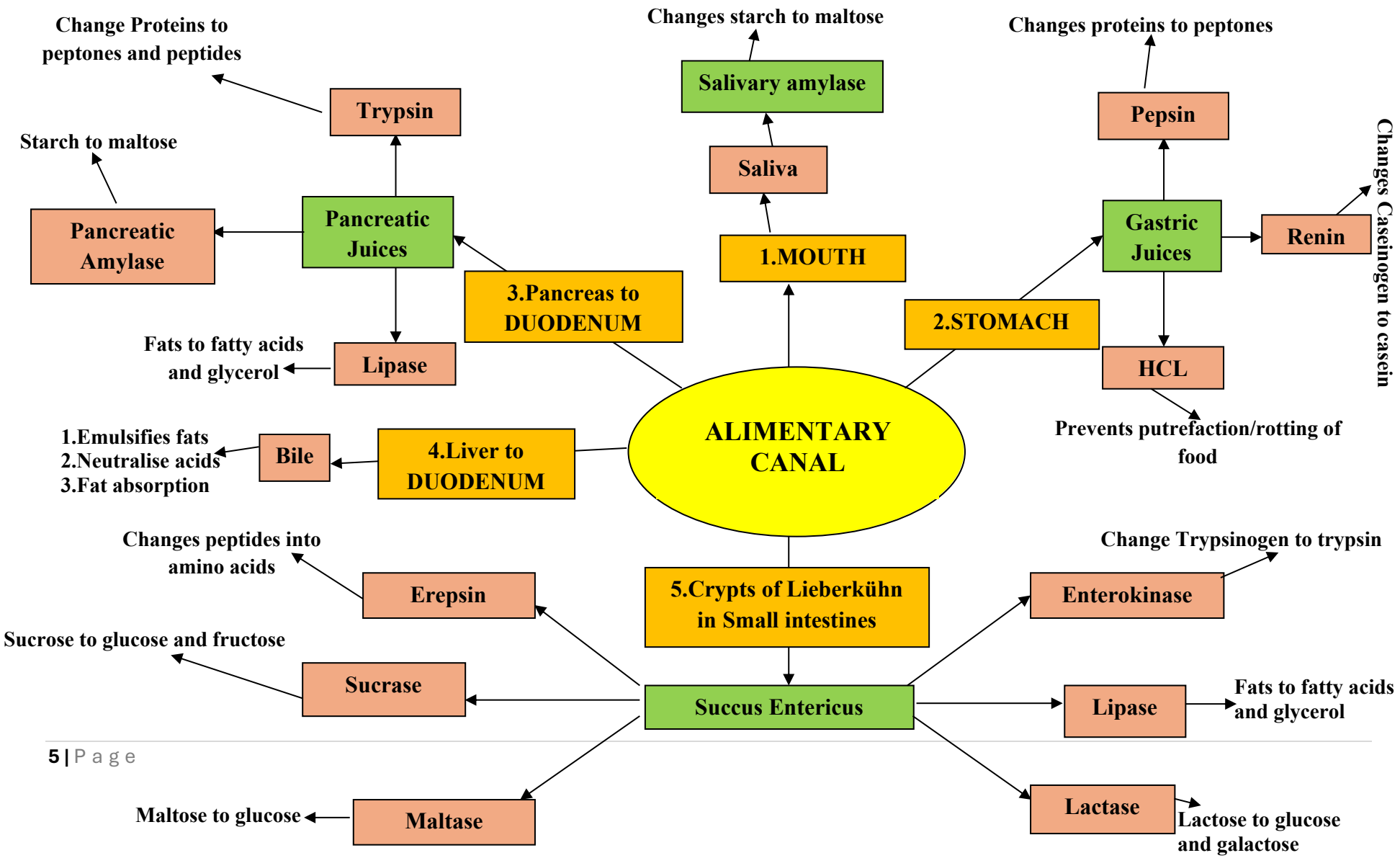
SCAN ME

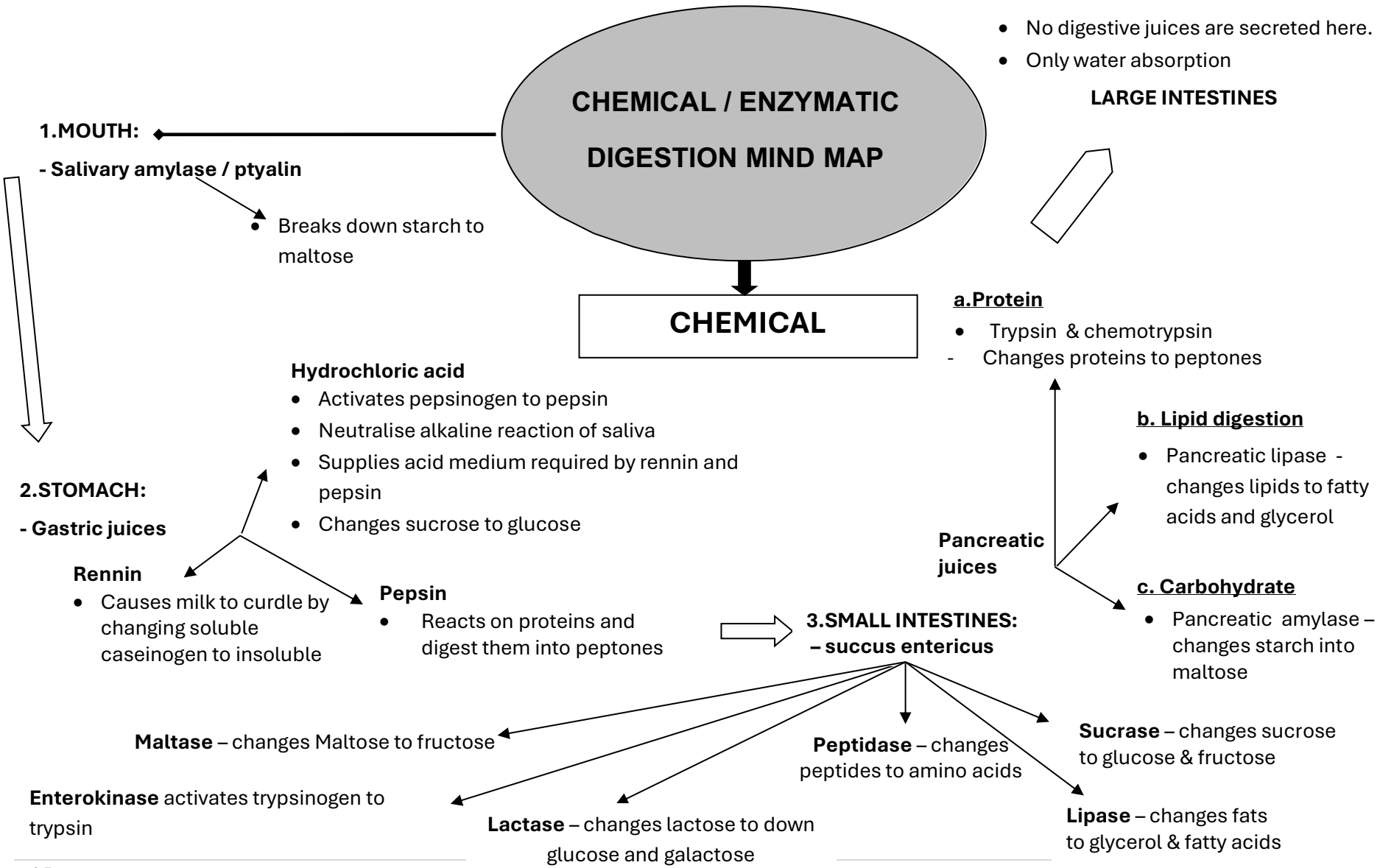
CONTENTS **PAGE**

ALIMENTARY CANALS

Part of alimentary canal	Pig	Cattle/sheep	Fowl
1. Mouth	• Thick upper lip and small pointed lower lip	• 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 jaw, 6 in 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
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 than small intestines but much wider • Divided into caecum, colon, and rectum • A large portion of the colon is sacculated	• Colon not as wide as in the pig and also not sacculated	• Two caeca • No colon • The 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
CHEMICAL
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
Rennin
Causes milk to curdle by changing soluble caseinogen to insoluble
Pepsin
Reacts on proteins and digest them into peptones
3.SMALL INTESTINES: – succus entericus
Maltase – changes Maltose to fructose
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

ACCESSORY DIGESTIVE GLANDS AND THEIR FUNCTIONS

1. THE LIVER

Largest gland in the body

- **Functions:**
  - Stores glycogen
  - Detoxifies poisons in bloodstream
  - Stores vitamins A, D, E and K
  - Stores copper and iron
  - Helps in the forming of blood
  - Responsible for the synthesis of certain proteins e.g. prothrombin
  - Secretes bile which is collected and stored in gall bladder

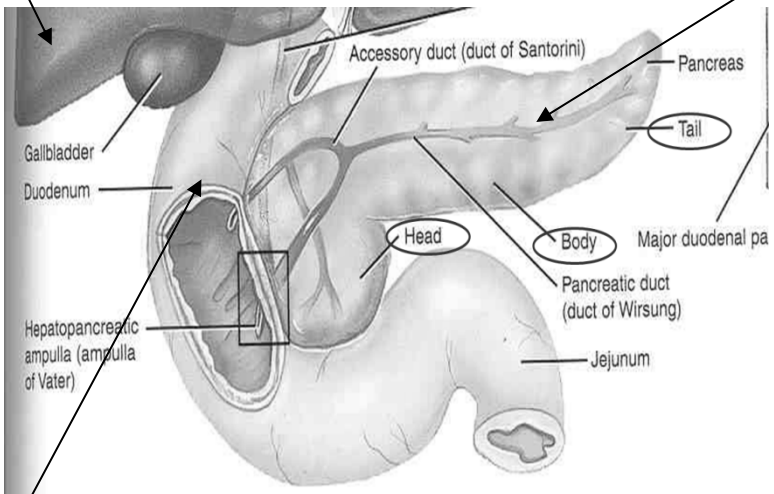
Functions of bile

- Emulsification(breaks down fats into small droplets)
- Neutralise stomach acid
- Creates an alkaline medium in duodenum for enzymatic action
- Bile salts are necessary for the absorption of fatty acids from intestines
- Bile salts helps in the absorption of fat soluble vitamins A, D, E and K
- Has a binding effect on chime
- Bile transports certain bile pigments to be transported down in the intestines and excreted

2. THE PANCREAS

- The pancreas has two functions and a double structure:
  - Exocrine portion, which secrete pancreatic juice
  - Endocrine portion (Islets of Langerhans), which secretes hormones (e.g. insulin)

- The pancreatic juice: is a clear, distinctly alkaline fluid which contains many enzymes. The secretion of pancreatic juice is controlled by the hormone secretin.



Functions of intestinal juice:

- Enterokinase activates trypsinogen to trypsin
- Maltase converts maltose to glucose and fructose
- Sucrose converts sucrose to glucose and fructose
- Lactase changes lactose to glucose and galactose
- Lipase digests fats and changes them into glycerol and fatty acids
- Peptidase breaks down peptones into amino acids

3. THE INTESTINAL GLANDS

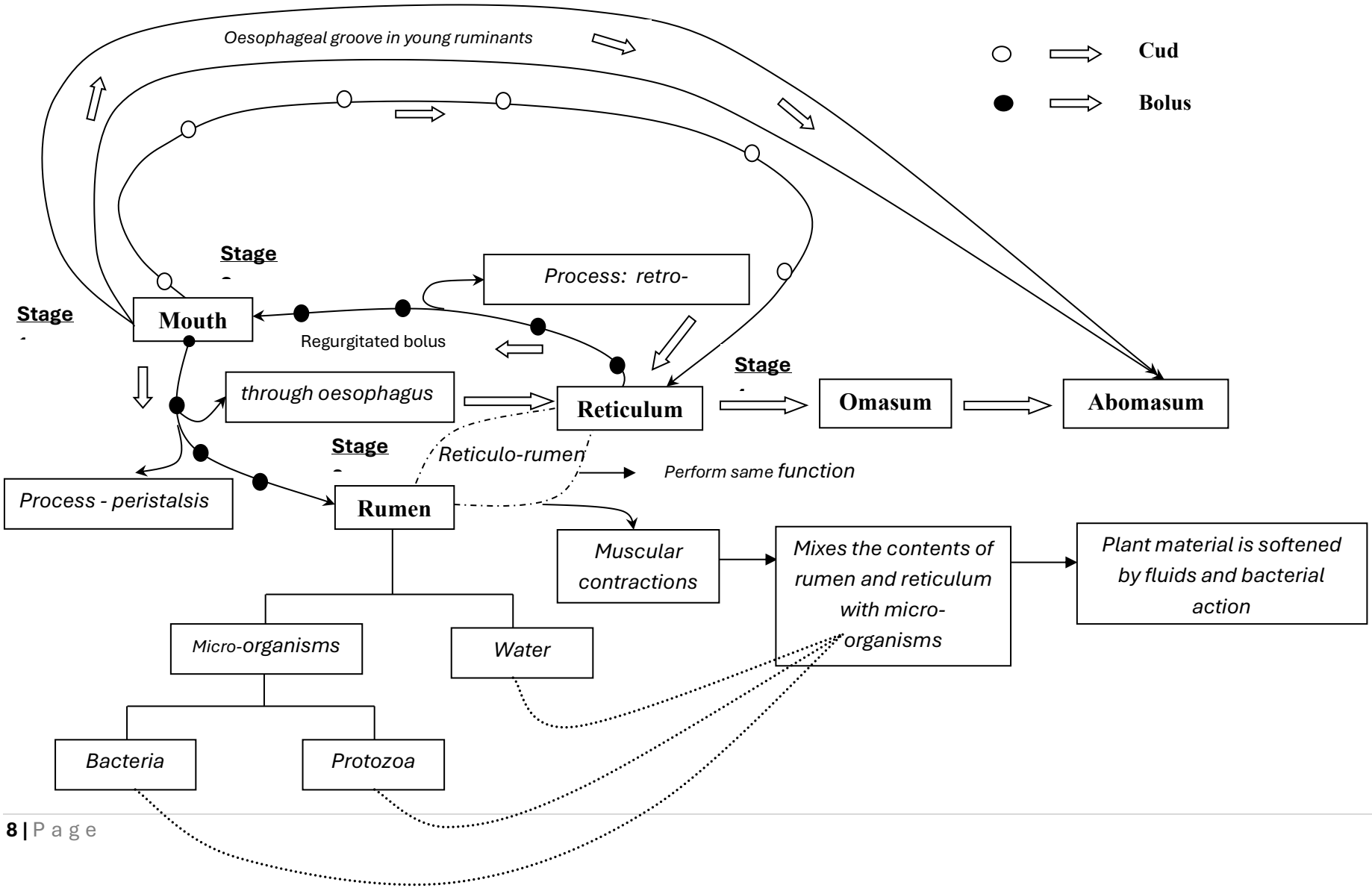
Brunner's glands

- **Located in the duodenum (in SI)**
- They secrete alkaline mucus(contains bicarbonates) which protects the mucosa of the small intestines from acidic stomach chyme.

Crypts of Lieberkühn)

- Located in between the villi (*indentation between villi*)
- Produces intestinal juices also called succus entericus

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 concentration.

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.
Such movement in contrast to diffusion and osmosis requires energy

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 methane
- Vit B complex

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)

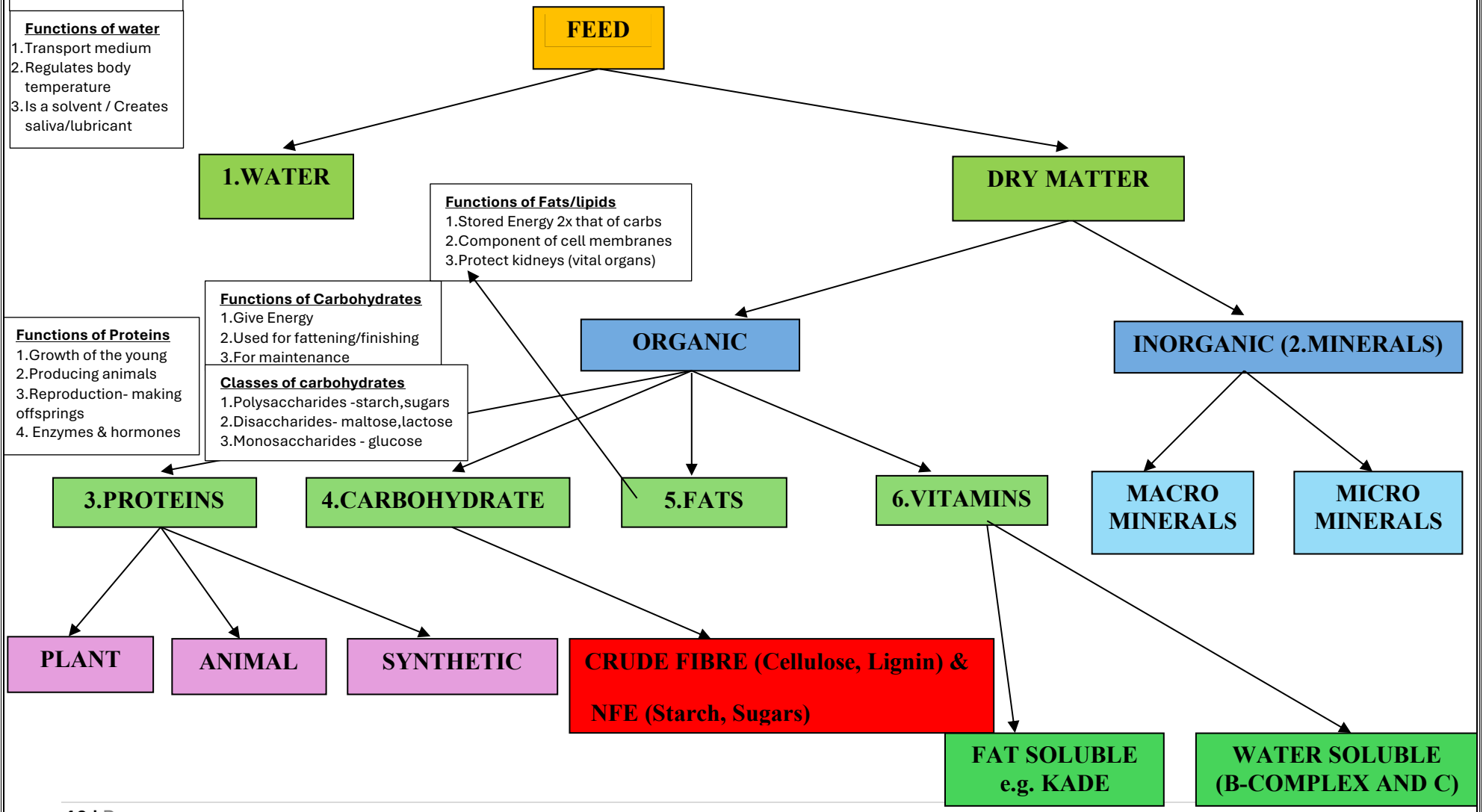
7. Absorption in the large intestines:

- 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

Sources of water
1.Drinking water
2.Water in feed
3.Metabolic water

Functions of water
1.Transport medium
2.Regulates body temperature
3.Is a solvent / Creates saliva/lubricant



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

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 division

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]
- [plays a role in synthesis and functioning of

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]

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.

	Function	Deficiency symptoms	Sources
CALCIUM	• Healthy bones and teeth • Blood clotting • Maintenance of pH of the body • Healthy nervous system and muscle tissue	• rickets in young animals • osteomalacia in older animals • milk fever in high producing dairy	bonemeal
PHOSPHORUS	• Healthy bones and teeth • Metabolism of carbohydrates • Formation of proteins, nucleic acids & cell	• rickets in young animals • osteomalacia in older animals • milk fever in high producing dairy	bonemeal
MAGNESIUM	• Healthy bones • Metabolism of carbohydrates • Activation of enzyme systems	• Tetanus (muscle contraction) • Nervousness, hypersensitivity • Slow growth • Drop in milk production	bonemeal
POTASSIUM	• Metabolic function • Normal digestion • Regulate acidity	• Slow growth • Reduced feed and water intake • Lower feed efficiency • Muscular weakness	young plants containing adequate amounts of potassium
SODIUM AND CHLORINE	• Essential for water metabolism • Essential for nutrient uptake and transmission of nerve impulses	• Craving for salt • Loss of appetite • Decreased growth • Reduced milk production	salt mixes containing added iodine and cobalt
SULPHUR	• Metabolic function • Amino acid and vitamin formation in rumen	• Protein deficiency • Poor performance	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	**Sources**: marine salts
ZINC	• Healing of damaged tissues • Hair and feather development • Enzyme activity	• **Parakeratosis** • Keratinisation of wool • Slow wound healing	**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 OF FEEDS and Biological Value of Feeds

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 and protein

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?

- ✓ To classify the feed or suggests the type of feed

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

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

THE BIOLOGICAL VALUE OF PROTEINS

The concept: Biological Value (BV)

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

Why is the BV important?

- ✓ **It allows us to compare the ability of various animal feeds to effectively supply all of the animals needs**
- ✓

• BV is an index of the quality of protein in the feed

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 ✓

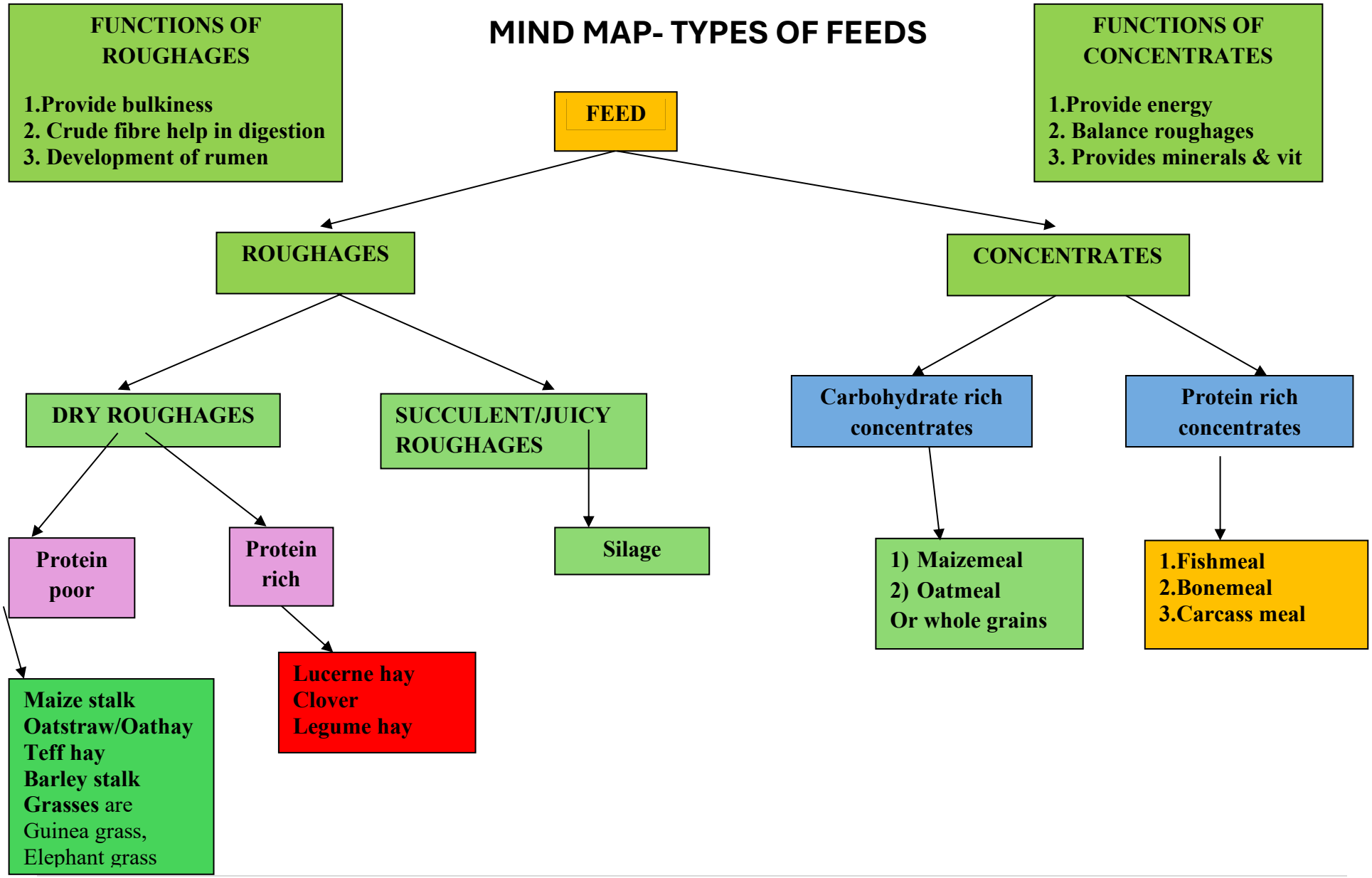
The Concept: Essential Amino Acid Index:

- ✓ 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 contains all amino acids in the right proportions.

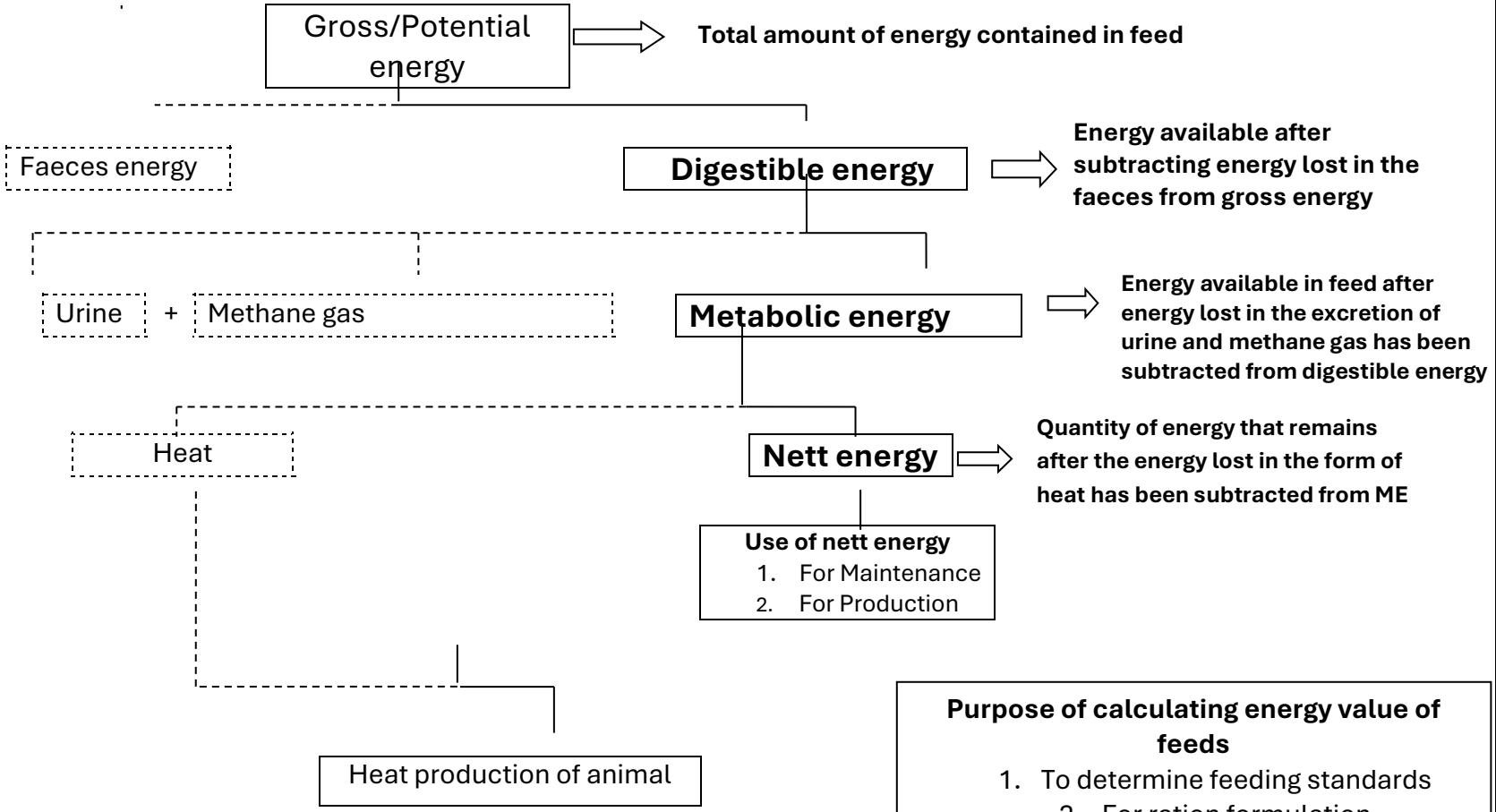
Importance of animal proteins in rations:

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

MIND MAP- TYPES OF FEEDS



ENERGY FLOW IN AN ANIMAL



Purpose of calculating energy value of feeds

1. To determine feeding standards
2. For ration formulation
3. For animal diet

FORMULAE TO CALCULATE DIGESTIBLE, METABOLISABLE AND NETT ENERGY

- ✓ **Digestible energy (DE)** = Gross energy (GE) – Energy lost in faeces
- ✓ **Metabolic energy (ME)** = Digestible energy (DE) – energy lost in urine and methane gases
- ✓ **Nett energy (NE**) = Metabolic energy (ME) – Energy lost as heat OR **NE** = GE – faeces – urine and gases – heat energy loss

NUTRITIVE RATIO

Nutritive value of a feed:

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

Nutrient	Value
Calcium	20 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 fattening ratio.

Calculating the nutritive ration of a feed:

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

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

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

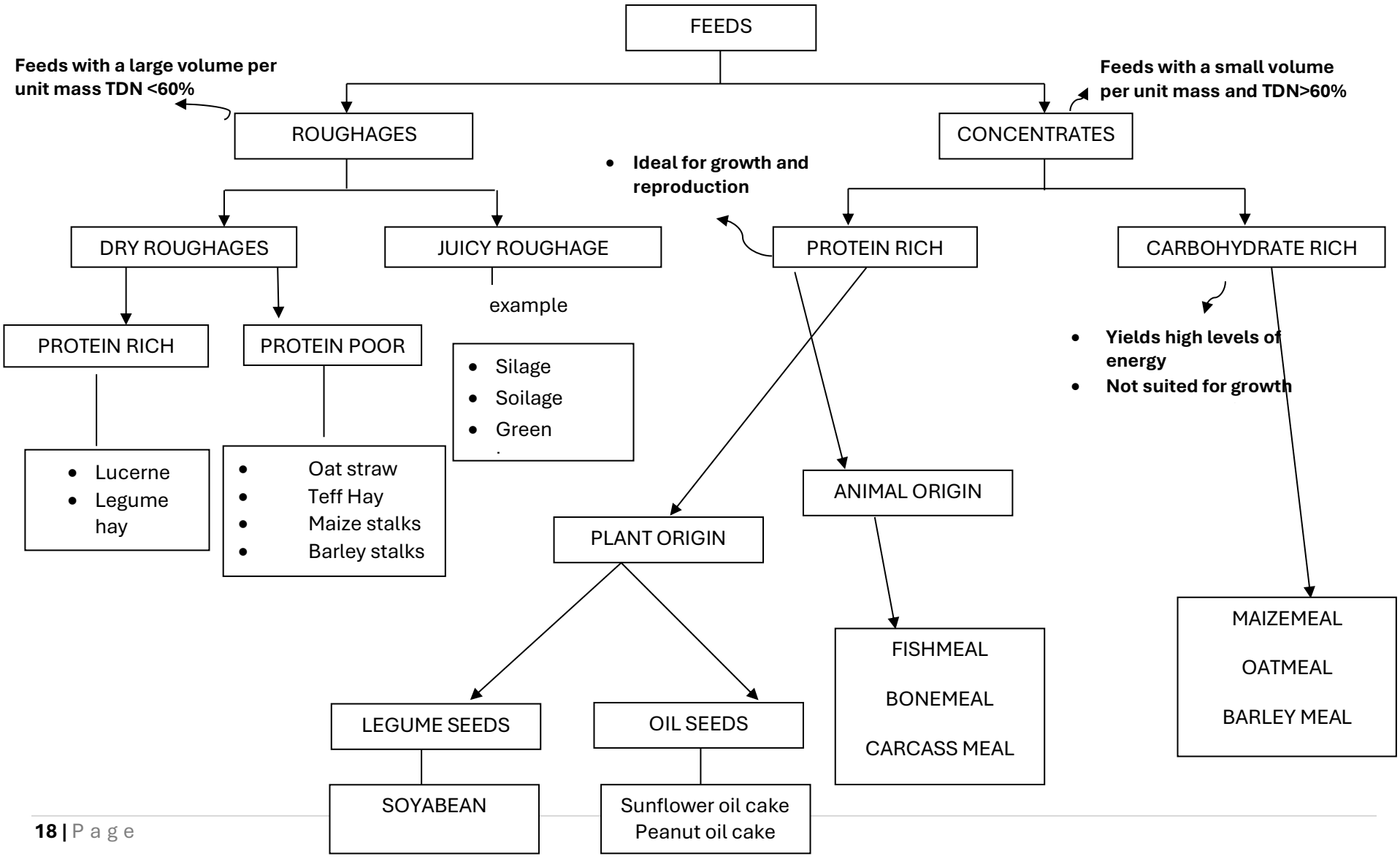
- ✓ **NARROW nutritive ratio (i.e. NR < 1:6) , rich in proteins and good for Growth, Production and Reproduction (GPR)**
- ✓ **WIDE nutritive ratio (i.e. NR > 1:6, rich in carbohydrates and suitable for Fattening or finishing, Energy and Maintenance (FEM)**

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,	Requires carbohydrates	Requires carbohydrates	Sufficient carbohydrates	Requires carbohydrates

TYPES OF FEEDS



PLANNING A FEED FLOW PROGRAMME – The Pearson's Square

Types of ration:

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

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

Why do we need a feed flow programme?

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

The Pearson's Square Method

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

The approach:

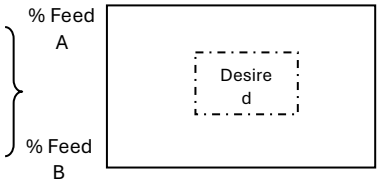
- ✓ Feeds with varying nutritional values have to be combined and balanced to meet the maintenance and production needs of an animal

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

The method:

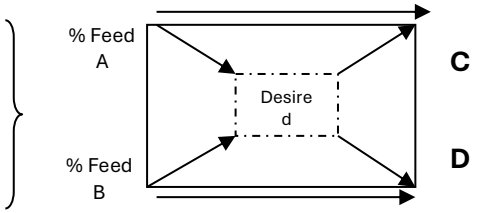
Step 1: Draw a square and place

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



Step 2:

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



Step 3:

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

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

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

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).

ANIMAL REPRODUCTION

REPRODUCTIVE TECHNIQUES

2.EMBRYO TRANSFER

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 ER

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 R

- 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 R

- It is expensive
- Requires expertise/skill
- Cloned animals have a shorter lifespan

TWO benefits of ET to farmers

- More progeny produced from best cows
- 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

3.NUCLEAR TRANSFER

ADVANTAGES OF CLONING

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

DISADVANTAGES OF CLONING

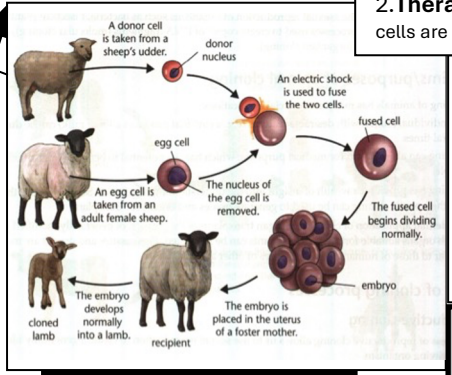
- It is expensive
- Large offspring cause dystocia
- Clones have short lifespan

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.



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.

1.ARTIFICIAL INSEMINATION

Methods to collect semen

- Artificial vagina
- Electrical stimulator

Semen evaluation

Macroscopic
– Milky, sticky, volume of 4ml
Microscopic
-80% mobile, < 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

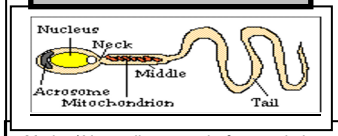
Advantages of AI

- 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



Mating/AI usually occurs before ovulation, so sperm arrive in the fallopian tubes –before—the release- of the- ovum. Sperm can stay alive and-viable for 24-48 hours in the uterus or fallopian tubes.
The sperm approach the zona pellucida of the egg cell to penetrate.
The acrosome reaction is a structural change of the head of the sperm that release the enzyme hialurodinase from the acrosome. These enzymes dissolve the covering of the ovum so that the sperm can penetrate.
Since a large quantity of enzymes is required to dissolve the wall of the ovum, a few million sperms are required to ensure fertilisation.
Thereafter, the ovum becomes impenetrable to other spermatozoa.The head of the spermatozoon fuses with the nucleus of the ovum to form a diploid zygote. The 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

Bull & Cow

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 ejaculation.

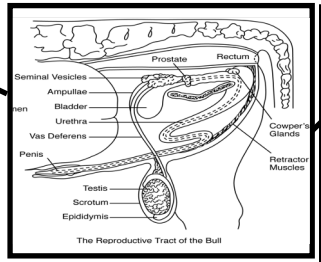
BULL
1.Testes (primary)
- Produce sperms
- Produce testosterone

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

3. **Vas deferens**
- Transports sperms

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

5. **Penis**
- Organ of copulation



The Reproductive Tract of the Bull

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

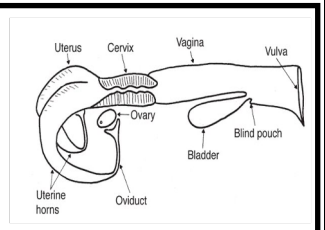
2. Oviducts (fallopian tubes)
- Transports ova
- Site of fertilisation

3. Uterus
- development of the foetus

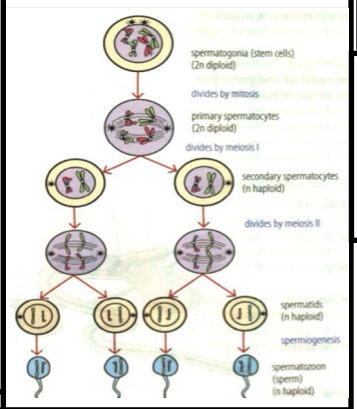
4. Cervix
- barrier during pregnancy
- mucus/ thick plug that blocks bacteria

5. Vagina – for copulation; birth canal

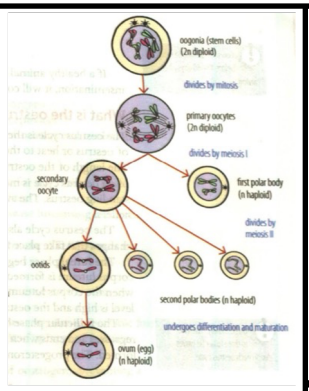
6. Vulva – pass urine



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



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 decrea
- Allows Mating

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**
Progesterone and later Prostaglandin

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 organs:

Factors regulating mating in bulls
- Pheromones ✓
- Sight ✓
- Experience ✓
- Testosterone ✓

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 ✓

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
- **Pedometer** is strapped inlower leg
- **Vasectomised bulls** used to detect heat

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

Anoestrus: the cow does not exhibit normal oestrus cycles.

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 and LH.

AGRICULTURAL PRODUCTION FACTORS

LAND

Economic functions of soil
- Provides space
- Supplies raw materials
- Supplies food
- Supplies raw materials
- Asset used as collateral in funding

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

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

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

LABOUR

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

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

Types of labour based on skill
- Skilled – e.g. nutritionists
- Semi-skilled- e.g.Driver
- Unskilled - e.g. harvesters

Increasing labour productivity
- **Increasing economic conditions of workers**

e.g., *incentives, high wages, bonuses*, medical aid
- **Improving educational conditions**

e.g.(Training, skills development, workshops)
- **Improving environmental conditions**

e.g.(better housing, facilities to socialise,clean water
- **Improving working conditions**

e.g.*(Protective clothing,supervision,Leave days)*
- Economic, Daily and Physical farm **Planning**
- **Addressing HIV/AIDS**

e.g.(Awareness, give medication, condoms, abstain)
- Efficient mechanisation

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

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

MANAGEMENT

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

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

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

CAPITAL

Creation of capital
- Production profit from operations
- Savings
- Credit , loans, grants

Types of capital- credit/period
- Fixed capital –Long term credit (10-30yrs)
- Movable capital -Mediumm term credit(2-9 yr
- Working capital –short term credit(less 2 yr)

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

Problems associated with capital
- Scarcity
- High risk
- Depreciation
- High interest rates
- Under/overcapitalisation

Components of a cash flow statement
- Income
- Expenditure
- Profit or loss
- Opening balance
- Closing balance
- Contains only cash items

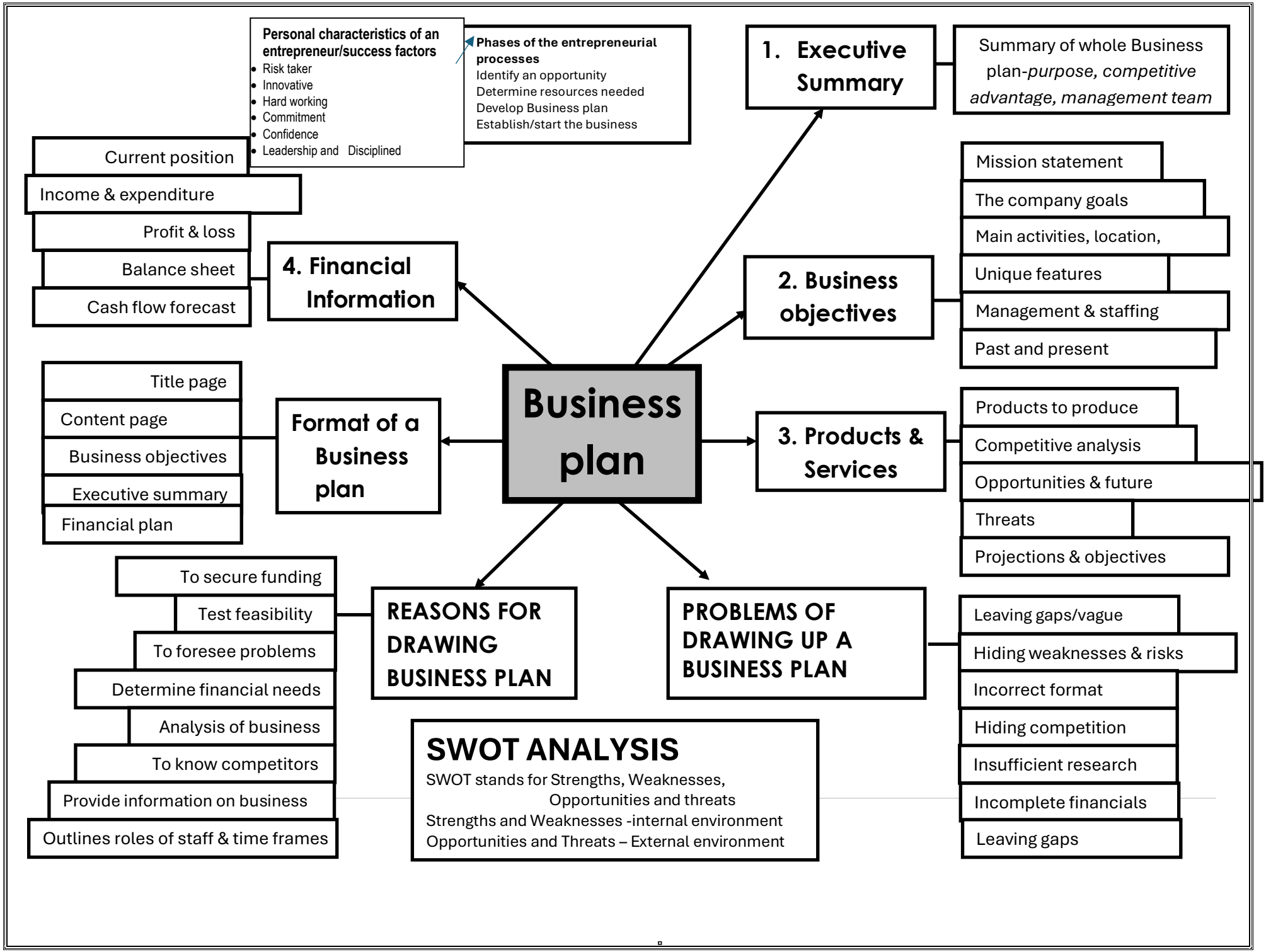
Financial Management Systems
- Keeping the records
- Keeping inventory of assets
- Keeping cash analysis book
- Preparing a balanced sheet
- Preparing an income statement

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

Cash flow statement-shows flow of cash in or out of business for a specific period.
Income statement- summary of all income and expenditure for a given period.

Sources of risk: Technologicall skills, Production risks, Market or price risks, Financial risks. Climate risk. Political risk. Health risk

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


Business plan
1. Executive Summary
Summary of whole Business plan-purpose, competitive advantage, management team
2. Business objectives
Mission statement
The company goals
Main activities, location,
Unique features
Management & staffing
Past and present
3. Products & Services
Products to produce
Competitive analysis
Opportunities & future
Threats
Projections & objectives
4. Financial Information
Current position
Income & expenditure
Profit & loss
Balance sheet
Cash flow forecast
Format of a Business plan
Title page
Content page
Business objectives
Executive summary
Financial plan
REASONS FOR DRAWING BUSINESS PLAN
To secure funding
Test feasibility
To foresee problems
Determine financial needs
Analysis of business
To know competitors
Provide information on business
Outlines roles of staff & time frames
PROBLEMS OF DRAWING UP A BUSINESS PLAN
Leaving gaps/vague
Hiding weaknesses & risks
Incorrect format
Hiding competition
Insufficient research
Incomplete financials
Leaving gaps
Personal characteristics of an entrepreneur/success factors
Risk taker
Innovative
Hard working
Commitment
Confidence
Leadership and Disciplined
Phases of the entrepreneurial processes
Identify an opportunity
Determine resources needed
Develop Business plan
Establish/start the business
SWOT ANALYSIS
SWOT stands for Strengths, Weaknesses, Opportunities and threats
Strengths and Weaknesses -internal environment
Opportunities and Threats – External environment

AGRICULTURAL MARKETING

FUCTIONS OF AGRICULTURAL MARKETING

- Packaging
- Processing
- Storage
- Transportation

THREE advantages of processing

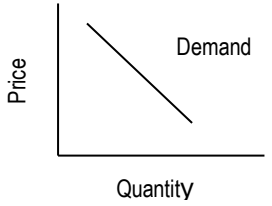
- Available throughout the year
- Prevent the spoilage/wastage
- Longer shelf life
- Improves the safety of products
- More convenient/easier packaging/handling/transport
- Adds value/higher income/profit
- Provides employment

Prevent over supply

Demand and supply

- **The law of demand**

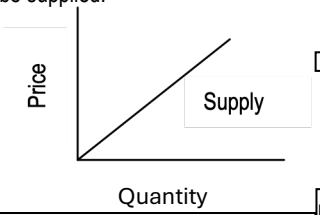
The higher the price, the less will the demand of a certain item.



Demand and supply

- **The law of supply**

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



Factors affecting the demand for a product

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

Factors affecting the supply of a product

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

Marketing	Selling
Emphasis is on the product	Emphasis is on customer want
Sales-volume oriented	Profit-oriented
Planning is short-term	Planning Is long-term
Focuses seller needs	Focuses on the wants of buyer

Principles of co-operative marketing

- Members' economic participation
- Voluntary and open membership
- Democratic member control
- Autonomy and independence

Advantages of Pool system

More bargaining power
Risks are shared by members
Access to funding/experts/infrastructure
Bulk selling , Low marketing costs

Types of co-operative marketing
- Services co-operatives
- Financial co-operatives
- Consumer co-operatives
- Production co-operatives
- Marketing co-operatives

Factors that might hamper marketing

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

Measures to prevent over supply of produce

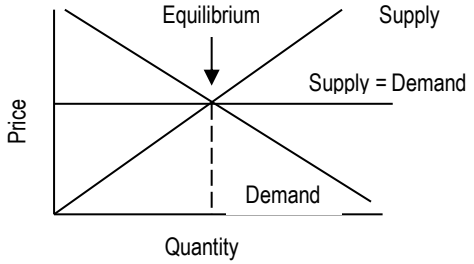
- Processing
- Building storage facilities
- Establishing new markets
- Diversification
- Hedging (contracts)
- Dumping produce
- Controlled marketing
- Reducing production
- Improving promotion and advertising of produce

Ways to streamline and improve Agri-business chain.

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

THE MARKET EQUILIBRIUM:

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



- **Develop market strategy/mix**
  - Product
  - Price
  - Place
  - Promoting products

Ways of promoting the product

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

Advantages/Benefits of co-operative marketing

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

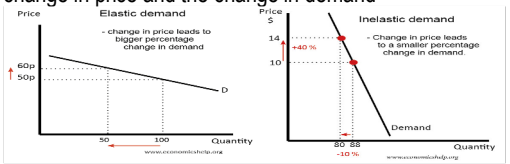
Guidelines for packaging

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

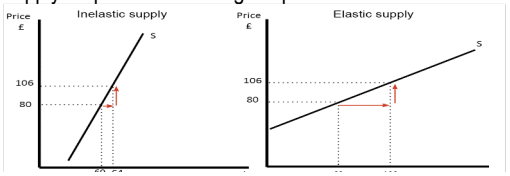
Specification for Containment

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

Price Elasticity of demand: the relationship between a change in price and the change in demand



Price Elasticity for Supply: a measure of how the supply responds to a change in price.



Agricultural Marketing Systems:

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

Advantages of a free market

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

Disadvantages

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

Market channels of a free market:

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

Sustainable Agricultural Marketing

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

Approaches to marketing:

- Niche marketing
- Mass marketing
- Multi-segment marketing

Market segmentation
(dividing market into smaller groups) based on income, geography, demography, behaviour

PRACTICE QUESTIONS - grouped

BULL REPRODUCTIVE ORGANS

4.1 The diagrams below represent the reproductive organs of a bull, the processes of sperm formation and the development in the sex cells.

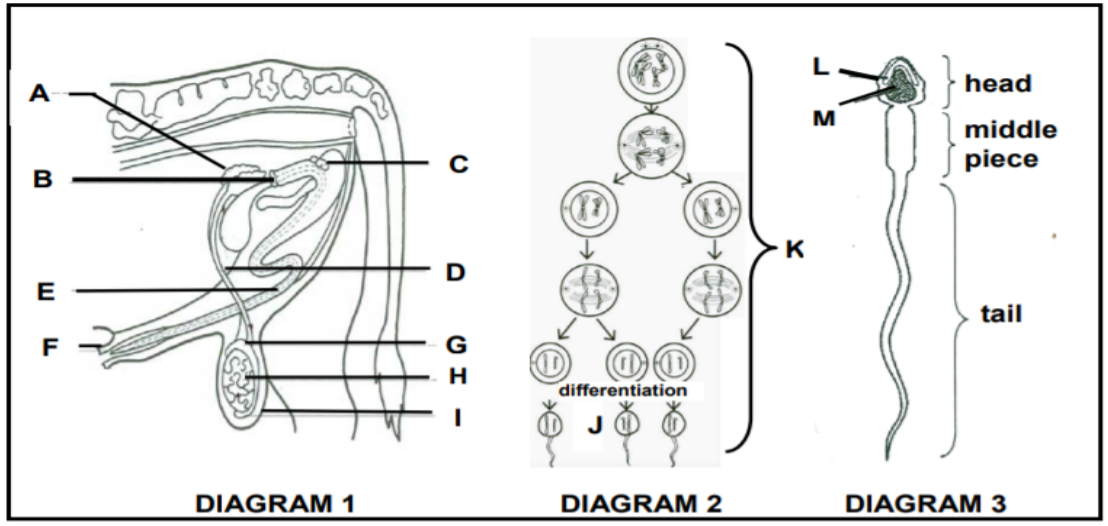


DIAGRAM 1 DIAGRAM 2 DIAGRAM 3

4.1.1	Name parts **A**, **B**, **C** and **H**.	(4)
4.1.2	Identify process **K**.	(1)
4.1.3	State ONE function each of parts **D** and **L**.	(2)
4.1.4	Describe how congenital defects can influence the process in DIAGRAM 2.	(2)
4.1.5	Give a reason why part **H** in DIAGRAM 1 is situated outside the abdominal cavity of a male animal.	(1)

4.1 **Reproductive organs of a bull**

4.1.1 **Reproductive parts**
A – Seminal vesicle/vesicular gland✓
B – Prostate gland✓
C – Cowper/bulbo-urethral gland✓
H – Testis✓ (4)

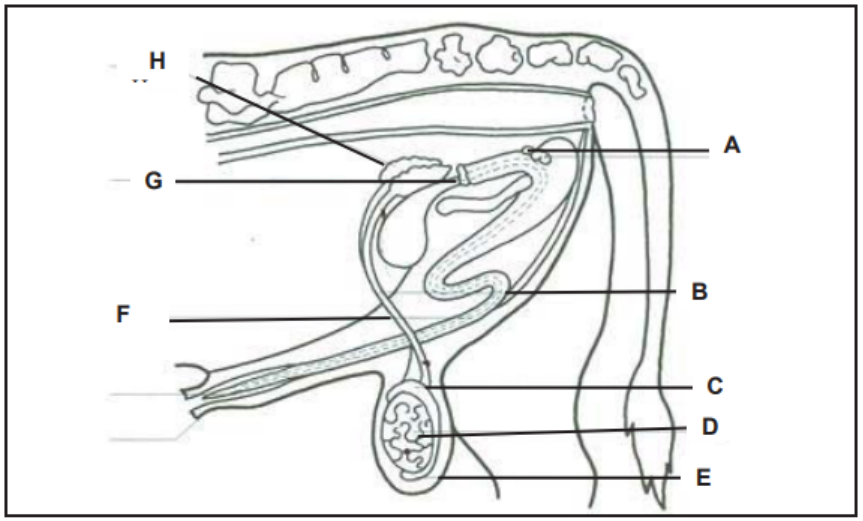
4.1.2 **Process that occurs in K**
Spermatogenesis/ sperm formation/gametogenesis✓ (1)

4.1.3 **Functions**
D - Transports spermatozoa/enhances ejaculation✓
L - Facilitates penetration of ovum/releases an enzyme (hyaluronidase) that allows spermatozoa to penetrate the ovum/acrosome reaction✓ (2)

4.1.4 **Influence of congenital defects**
- Negatively affects sperm formation/spermatogenesis/will not allow optimum spermatogenesis to take place/sperm defects✓✓ (2)

4.1.5 **Reason for part H to be situated outside the abdominal cavity**
Sperm production occurs at the temperature slightly (1 to 3˚C) lower than that of the body/to regulate the temperature for more effective spermatogenesis✓ (1)

4.1 The diagram below shows the reproductive system of a bull.



4.1.1 Identify the letter from the diagram above representing the part where the following occurs:

(a) Secretes a sticky liquid that provides energy for the sperms (1)

(b) Transports sperm cell to the urethra through peristalsis movement (1)

(c) Produces testosterone (1)

(d) Secretion of milky alkaline mucus that gives semen its smell (1)

4.1.2 Part labelled **E** regulates temperature for the sperms. Justify this statement by explaining how this is done under extreme temperature conditions. (2)

4.1 **Reproductive system of a bull**

4.1.1 **Identification of the letter**

(a) H √ (1)

(b) F √ (1)

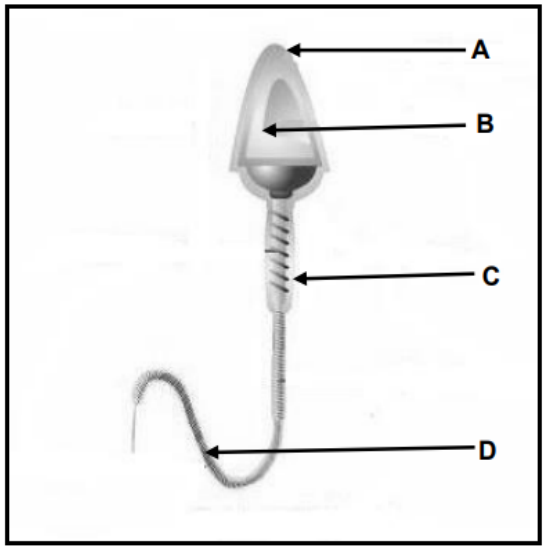
(c) D √ (1)

(d) G √ (1)

4.1.2 **Explanation of how scrotum regulates temperature under extreme temperature conditions**

When it is cold the scrotum draws the testes closer to the body √ and when it is hot it moves them away from the body. √ (2)

4.1 The diagram below represents a sperm cell.



4.1.1 Identify part **A**. (1)

4.1.2 Give a function of the parts labelled:

(a) **A** (1)
(b) **B** (1)
(c) **D** (1)

4.1.3 Distinguish between a *sperm cell* and *semen*. (2)

4.1.4 Name the female reproductive cell. (1)

4.1 **The diagram of a sperm cell**

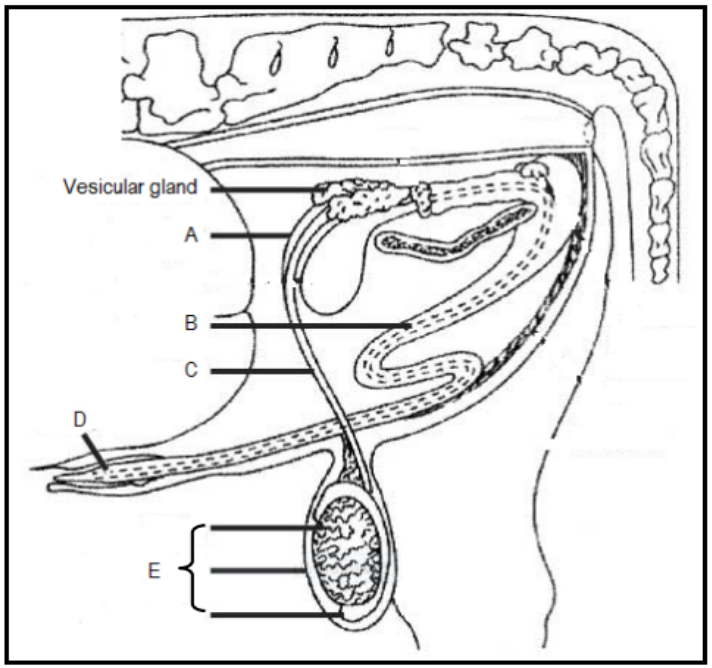
4.1.1 **Identification of part A**
Acrosome ✓ (1)

4.1.2 **The function of the part**
(a) **A -** Facilitate penetration of the sperm cell into the ovum/protects the head of the sperm cell ✓ (1)
(b) **B -** Transmission of DNA/genetic material/information ✓ (1)
(c) **D -** Mobility/movement of the sperm cell ✓ (1)

4.1.3 **Distinction between sperm cell and semen**
Sperm cell - Male gamete/reproductive cell for fertilisation ✓ (1)
Semen - Mixture of sperm cells and the fluids from the accessory glands ✓ (1)

4.1.4 **The female reproductive cell**
Ovum/egg cell/female gamete ✓ (1)

4.1 The diagram below represents the male reproductive system of a bull.



4.1.1 Identify part **A** and part **B**. (2)

4.1.2 State TWO functions of the secretion of the vesicular gland. (2)

4.1.3 Name a congenital defect of part **D** that can lead to an inability to service cows. (1)

4.1.4 Identify the effect on the fertility of the bull if part **E** is:

(a) Hanging very close to the body at all times due to a shorter scrotum (1)

(b) Totally removed (1)

4.1 **The male reproductive system**

4.1.1 **Identification of parts**

A Vas deferens/ampulla ✓ (1)
B Urethra ✓ (1)

4.1.2 **TWO functions of the secretion of vesicular gland**

- Provide nutrition/nourishing/energy to the sperm cells ✓
- Transportation of sperm cells ✓
- Protects the sperm cells against changes in pH/buffer ✓ (Any 2) (2)

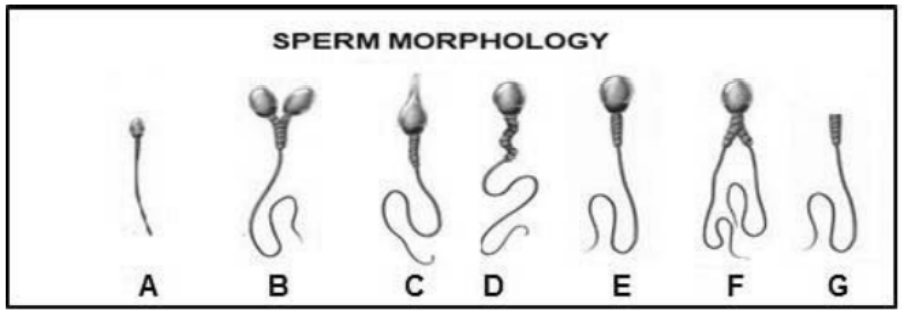
4.1.3 **Congenital defect of part D**

- Under-development/hypoplasia ✓
- Penis too short/too long ✓
- Abnormal openings ✓
- Short retractor penis muscle ✓ (Any 1) (1)

4.1.4 **Indication of the effect on the fertility of the bull**

(a) Affects spermatogenesis/low sperm count/sperm denaturing/ infertility ✓ (1)
(b) No sperm will be produced/sterile ✓ (1)

4.2 The diagram below illustrates different sperm cells.



4.2.1 Identify the letter (**A–G**) in the diagram above that represents a sperm cell with normal morphology. (1)

4.2.2 Name the process by which sperm cells are formed in the male testis. (1)

4.2.3 Explain how sperm cells **A** and **G** can cause infertility in a bull. (2)

4.2.4 List TWO characteristics of good quality semen. (2)

4.2 **Sperm morphology**

4.2.1 **Identification**
- E ✓ (1)

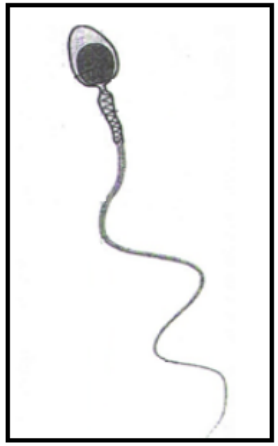
4.2.2 **Naming of the process**
- Spermatogenesis ✓ (1)

4.2.3 **Explanation of how sperm cells A and G can cause infertility in a bull**
A: The sperm cannot move to the point of fertilisation ✓ (1)
G: The sperm cannot fertilise the egg cell ✓ (1)

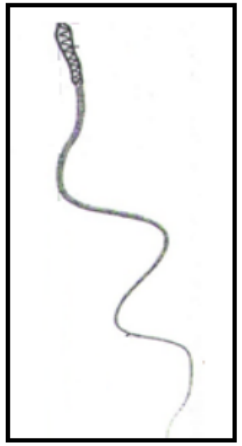
4.2.4 **TWO characteristics of good quality semen**
- It must be viable ✓
- Thick whitish to yellow fluid ✓
- It must have normal morphology ✓
- Should have no odour ✓
- Must have good sperm concentration ✓
- Correct pH ✓
- High motility rate ✓ (Any 2) (2)

4.2 The pictures below show the morphology of sperm cells.

SPERM CELL A



SPERM CELL B



SPERM CELL C

4.2.1 Name the process during which the sperm cells above are formed. (1)

4.2.2 Identify a high quality sperm cell. (1)

4.2.3 Name the instrument used to evaluate the sperm cells above during semen examination. (1)

4.2.4 Explain how sperm cell **B** and sperm cell **C** can affect the ability of a bull to fertilize a cow. (2)

4.2 **Sperm morphology**

4.2.1 **Process during which the sperm cells above are formed**
Spermatogenesis ✓ (1)

4.2.2 **Identification of the sperm cell that can constituting good quality semen**
Sperm cell A ✓ (1)

4.2.3 **Instrument to evaluate sperm cells**
Microscope ✓ (1)

4.2.4 **Explanation of how sperm cell in B and C affect the ability of the bull to fertilize**
SPERM CELL B - It cannot fuse with the egg cell because it does not have an acrosome/no head ✓ (1)
SPERM CELL C - It cannot move towards the point of fertilization since it does not have a tail ✓ (1)

4.2 In animal reproduction the bull is necessary to produce the sperm cell to fertilise a cow. If the bull is unable to fertilise a cow, it may either be sterile or infertile.

4.2.1 Differentiate between *sterility* and *infertility*. (2)

4.2.2 Name TWO congenital defects that may lead to sterility in bulls. (2)

4.2.3 State TWO conditions that may cause the inability of a bull to copulate. (2)

4.2 **Infertility and sterility in bulls**

4.2.1 **Differentiation between sterility and infertility**

Sterility is the total loss of fertility √ and infertility is the temporal loss of fertility √ (2)

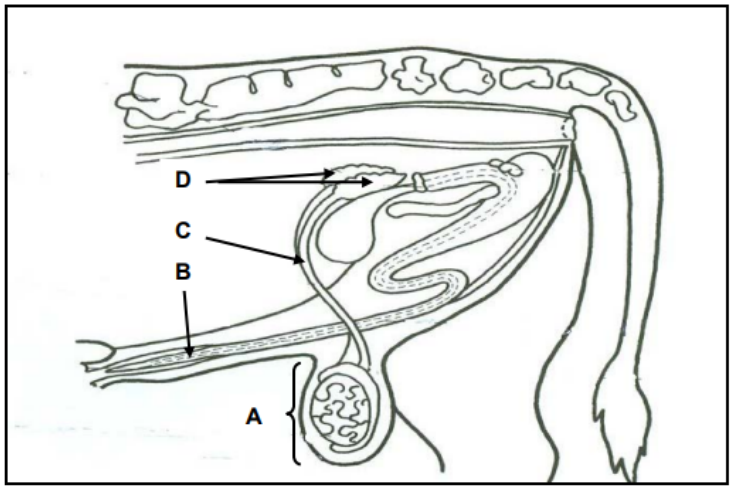
4.2.2 **TWO congenital defects leading to sterility in bulls**

- Hypoplasia √
- Cryptorchidism √
- Hermaphroditism √
- Sperm defects √ (Any 2 x 1) (2)

4.2.3 **TWO conditions that may cause inability of a bull to copulate**

- Injuries to the penis √
- Defective penis/corkscrew/too short √
- Poorly developed hind legs √
- Diseases causing inflammation of the joints √ (Any 2 x 1) (2)

4.1 The picture below shows the reproductive system of a bull.



4.1.1 Identify **A**, **B** and **C**. (3)

4.1.2 State ONE function of **A**. (1)

4.1.3 Indicate the role of gland **D**. (1)

4.2 Bulls may appear healthy and normal but lack the drive to service cows.

4.2.1 Give a term for the condition described in the statement above. (1)

4.2.2 State THREE causes of the condition given in QUESTION 4.2.1. (3)

4.1.1 **Identification of parts**

A Testes/scrotum ✓ (1)
B Penis/urethra ✓ (1)
C Vas deferens/seminal tube/ductus deferens/sperm duct ✓ (1)

4.1.2 **ONE function of testes**

- Secretion of hormone testosterone/male sex hormone ✓
- Production of sperm cells/male sex cells ✓ (Any 1) (1)

OR

ONE function of the scrotum

- Protects the testis ✓
- Regulates temperature of the testis ✓ (Any 1) (1)

4.1.3 **Role of seminal vesicles**

- Secrete fluid that transports the spermatozoa ✓
- Protect the semen against pH changes ✓
- Provide energy for sperm cells ✓ (Any 1) (1)

4.2 **Lack of libido in bulls**

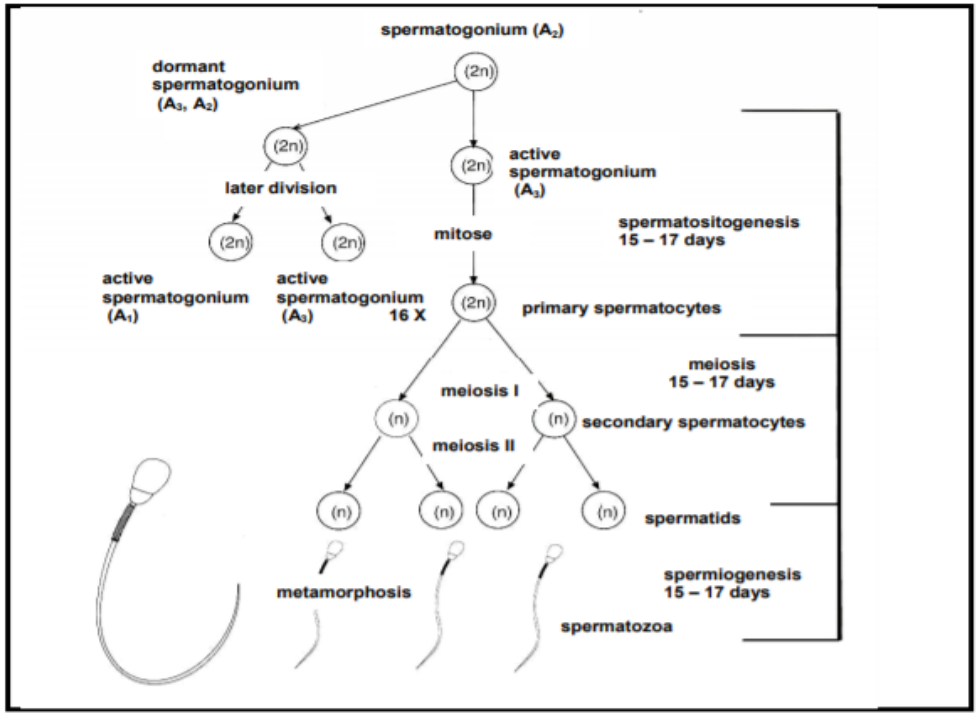
4.2.1 **Term for the condition**

Lack of libido ✓ (1)

4.2.2 **THREE causes of lack of libido**

- Immaturity/lack of experience ✓
- Overwork/exhaustion/over exertion ✓
- Malnutrition ✓
- Poor health/diseases/low testosterone ✓
- Change in environment ✓
- Stress ✓
- Temperament ✓
- Age/senility ✓ (Any 3) (3)

4.1 The illustration below shows the process of spermatogenesis that takes place in the male reproductive system.



4.1.1 Briefly describe the process of *spermatogenesis*. (2)

4.1.2 Name the organ where this process takes place in the male animal. (1)

4.1.3 Name the phase in the spermatogenesis process where mitotic cell division occurs. (1)

4.1.4 Explain the role of meiosis in the spermatogenesis process. (2)

4.1.5 Name TWO congenital factors that may disturb the spermatogenesis process. (2)

4.1 **The process of spermatogenesis**

4.1.1 The primary male sex cells develop in the tubules of the testis ✓ and
form spermatozoa ✓ (2)

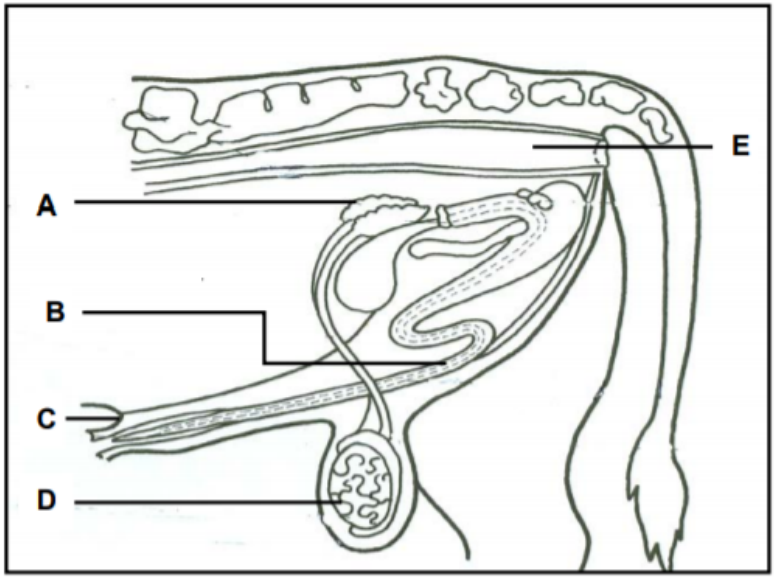
4.1.2 Testis ✓ (1)

4.1.3 Spermatocytogenesis ✓ (1)

4.1.4 The halving of the number of chromosomes in the reproductive cells ✓
To transport the genetic information to the reproductive cells (outflanking) ✓ (2)

4.1.5 Hypoplasia ✓
Cryptorchidism ✓
Sperm defects ✓ (Any 2) (2)

4.3 The diagram below illustrates the reproductive system of a bull.



4.3.1 Identify parts **A**, **B** and **D**. (3)

4.3.2 State the function of part **A**. (1)

4.3.3 State the function of the hormone secreted in part **D**. (1)

4.3.4 Briefly describe why part **D** is suspended from the animal body. (2)

4.3 **Male reproductive system**

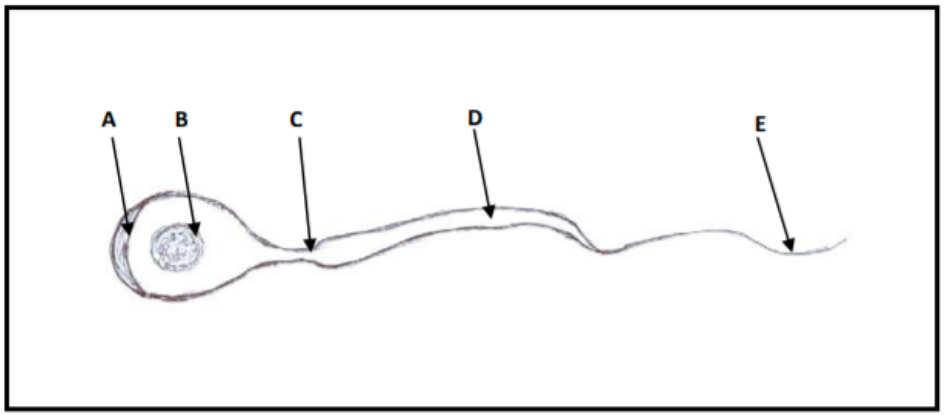
4.3.1 **Identification of labelled parts of the male reproductive system**
A - Vesicular gland/seminal vesicles✓
B - Penis✓
D - Testicles/testes✓ (3)

4.3.2 **Function of part labelled A**
Secretes a sticky yellowish fluid/seminal fluid✓ (1)

4.3.3 **Function of hormone secreted in part labelled D**
- Responsible for male characteristics✓
- Stimulates the process of sperm formation/spermatogenesis✓ (1)

4.3.4 **Reason for suspension of part labelled D**
- To regulate the temperature of the sperm cells/sperm formation /spermatogenesis ✓
- which requires a temperature slightly lower than the body temperature✓
- More airflow is possible over the structure that will cool it down during warm weather conditions✓ (Any 2) (2)

4.3 The diagram below illustrates a sperm cell.



4.3.1 Identify part **B**. (1)

4.3.2 Write down the letter of the part that represents the acrosome. (1)

4.3.3 Name ONE function of part **E**. (1)

4.3.4 Distinguish between a *sperm cell* and *semen*. (2)

4.3.5 Indicate TWO methods of collecting semen from bulls. (2)

4.3 **Schematic representation of a sperm cell**

4.3.1 **Identification of part B**
Nucleus ✓ (1)

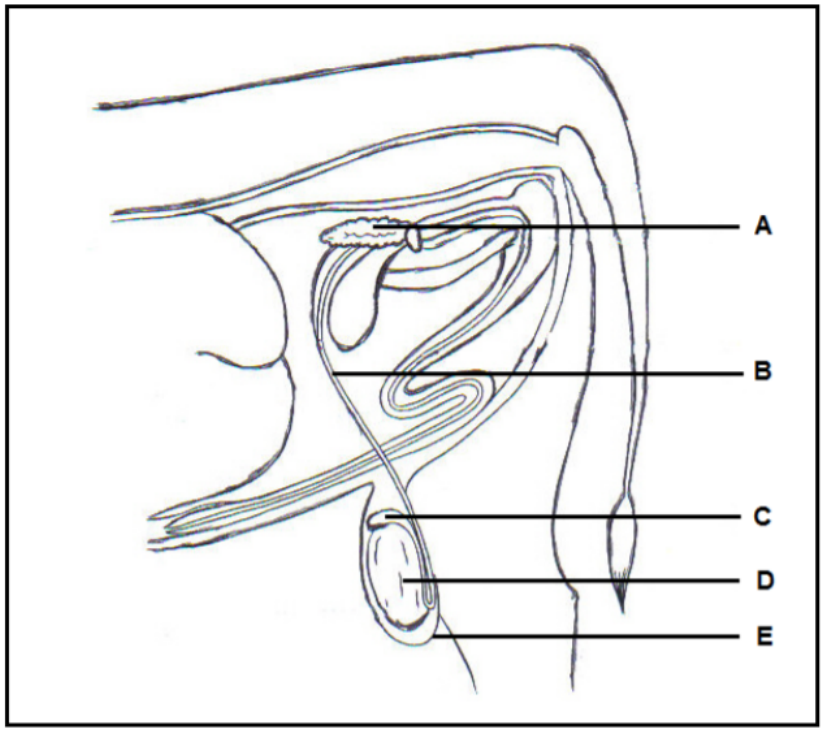
4.3.2 **Part representing acrosome**
A ✓ (1)

4.3.3 **The function of part labelled E**
Movement/mobility/motility of the sperm cell ✓ (1)

4.3.4 **Distinction between a sperm cell and semen**
- **Sperm -** Male gamete/reproductive cell ✓
- **Semen -** Mixture of sperm cells and fluids produced by accessory glands ✓ (2)

4.3.5 **TWO methods of collecting semen**
- Artificial vagina ✓
- Electrical stimulator/electrojaculator ✓ (2)

4.1 The diagram below represents the reproductive system of a farm animal.



4.1.1 Indicate the process that takes place in part **D**. (1)

4.1.2 Identify parts **A**, **B** and **E**. (3)

4.1.3 Name and explain TWO congenital defects of part **D** that lead to infertility. (4)

4.1.4 State TWO functions of part **C**. (2)

4.1.1 **Process in part D**

- Spermatogenesis✔ (1)

4.1.2 **Identify parts A, B and E**

- **Label A** – Seminal vesicles/vesicular glands✔
- **Label B** – Vas deferens/sperm duct✔
- **Label E** – Scrotum/scrotal sac✔ (3)

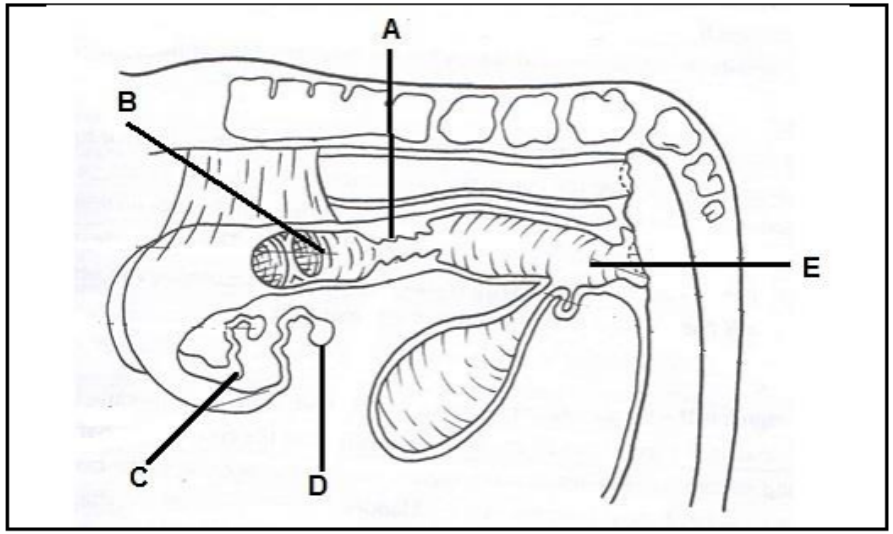
4.1.3 **TWO congenital defects of part D**

- **Cryptorchidism**✔ – the condition whereby the testes remain in the abdominal cavity and do not descend into the scrotum✔
- **Hypoplasia**✔– the condition whereby the testes are underdeveloped✔ (4)

4.1.4 **TWO functions of the part C**

- Storage of semen✔
- Maturation of sperms✔
- Secretion of buffer✔
- Transportation of semen✔
- Concentration of semen✔ (Any 2) (2)

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



4.1.1 Identify the animal with the reproductive system shown in the diagram above. (1)

4.1.2 Give TWO reasons visible in the above diagram to support your answer to QUESTION 4.1.1. (2)

4.1.3 Identify the letter representing the part responsible for the following functions:

(a) Gametes are formed (1)

(b) Fusion of male and female gametes (1)

(c) Implantation of the embryo (1)

4.1.4 Name TWO hormones produced in the part labelled **D**. (2)

4.1 **Reproductive system**

4.1.1 **Identification of the animal with the reproductive system**

- Cow √ (1)

4.1.2 **TWO reasons visible to support the answer**

- Presence of ovary √
- Presence of fallopian tubes √
- Presence of cervix √
- Presence of the vagina √ (Any 2 x 1) (2)

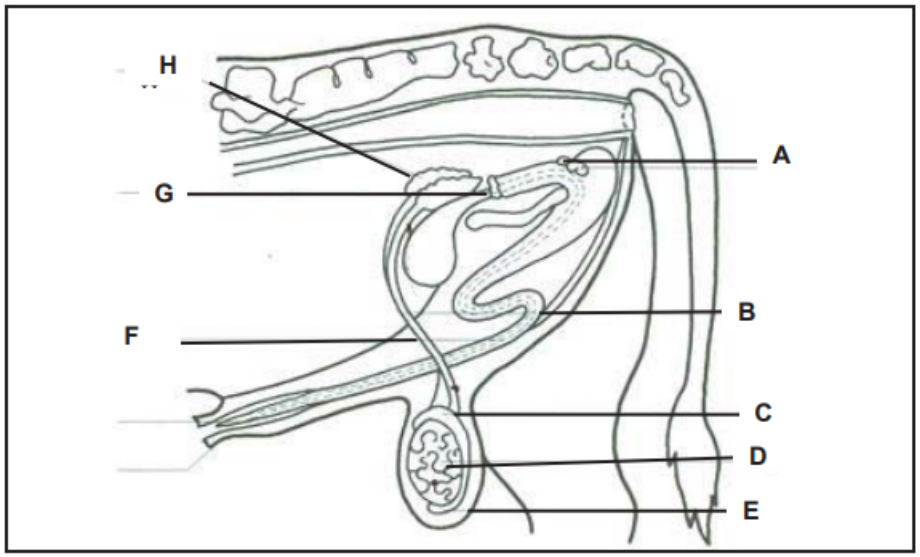
4.1.3 **Identification of the letter**

(a) D √
(b) C √
(c) B √ (3)

4.1.4 **TWO hormones produced in part labelled D/ovary**

- Oestrogen √
- Progesterone √ (2)

4.1 The diagram below shows the reproductive system of a bull.



4.1.1 Identify the letter from the diagram above representing the part where the following occurs:

(a) Secretes a sticky liquid that provides energy for the sperms (1)

(b) Transports sperm cell to the urethra through peristalsis movement (1)

(c) Produces testosterone (1)

(d) Secretion of milky alkaline mucus that gives semen its smell (1)

4.1.2 Part labelled **E** regulates temperature for the sperms. Justify this statement by explaining how this is done under extreme temperature conditions. (2)

4.1 **Reproductive system of a bull**

4.1.1 **Identification of the letter**

(a) H √ (1)

(b) F √ (1)

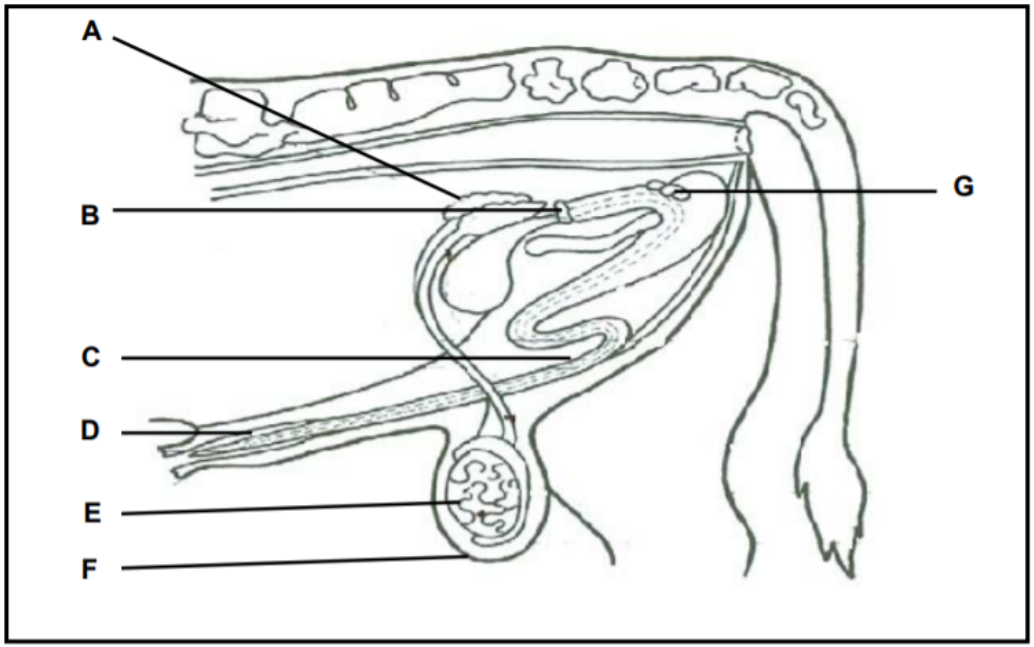
(c) D √ (1)

(d) G √ (1)

4.1.2 **Explanation of how scrotum regulates temperature under extreme temperature conditions**

When it is cold the scrotum draws the testes closer to the body √ and when it is hot it moves them away from the body. √ (2)

4.1 The diagram below represents the reproductive tract of a bull.



4.1.1	Identify parts **A** and **B**.	(2)
4.1.2	State ONE function of part **G**.	(1)
4.1.3	Indicate the role of the hormone secreted in part **E**.	(1)
4.1.4	Give a reason why part **F** is located outside the body of the bull.	(1)
4.1.5	Name the process used to remove part **E** in young calves.	(1)

4.1 **The reproductive tract of the bull**

4.1.1 **Identification of parts**

A Seminal vesicle/vesicular gland ✓ (1)

B Prostate gland ✓ (1)

4.1.2 **ONE function of part G**

Secretes the seminal fluid ✓ (1)

4.1.3 **The role of the hormone secreted in part E**

- Responsible for the development of the secondary male characteristics ✓
- Normal mating behaviour/enhance sexual behaviour/libido ✓
- Production/transportation of spermatozoa ✓
- Maintenance of optimal conditions for spermatogenesis ✓
- Maintenance of the male duct system ✓ (Any 1) (1)

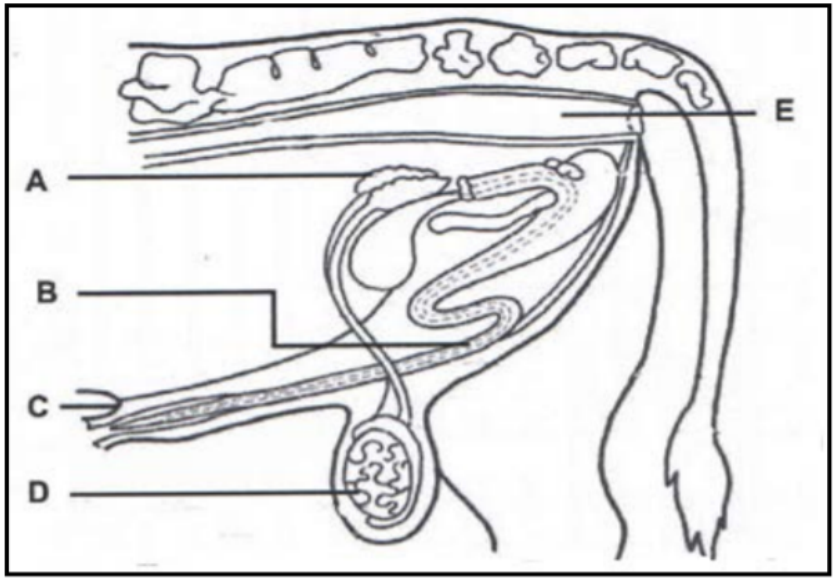
4.1.4 **Reason for part F located outside the body of the bull**

Regulate the temperature of the testis for spermatogenesis ✓ (1)

4.1.5 **The process used to remove part E in young calves**

Castration ✓ (1)

4.1 The diagram below represents the reproductive organs of a bull.



4.1.1 Write down the letter (**A**–**E**) that represents the part where the following takes place:

(a) A common excretory canal for urine and semen (1)

(b) Produces the male sex hormone (1)

(c) Secretes the liquid that serves as an energy source for sperm cells (1)

4.1.2 The bull may be sterile due to congenital defects in part **D**. Name TWO of these defects. (2)

4.1.3 State TWO functions of the hormone secreted by part **D**. (2)

4.1.1 **Reproductive organs of a bull**

(a) B ✓ (1)

(b) D ✓ (1)

(c) A ✓ (1)

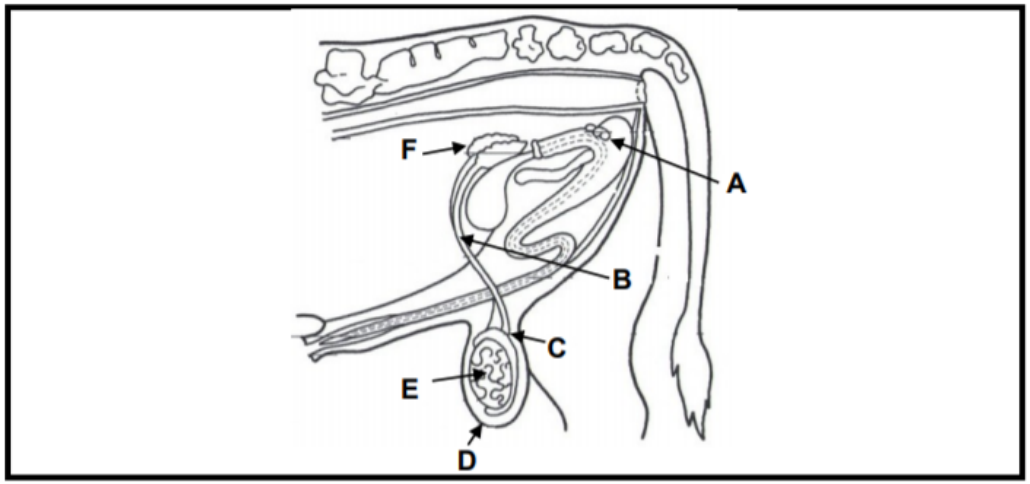
4.1.2 **TWO congenital defects**

- Sperm defects ✓
- Cryptorchidism ✓
- Hypoplasia ✓ (Any 2) (2)

4.1.3 **TWO functions of the hormone secreted by part D**

- Development of the secondary sex characteristics ✓
- Normal mating behaviour ✓
- Functioning of the accessory glands ✓
- Production of spermatozoa ✓
- Maintenance of the male duct system ✓ (Any 2) (2)

4.3 The diagram below is a reproductive system of a bull.



4.3.1 Indicate what is represented by part labelled **B**, **D** and **F** in the diagram above. (3)

4.3.2 Suggest TWO congenital defects in part labelled **E** that may lead to a complete loss of fertility in bulls. (2)

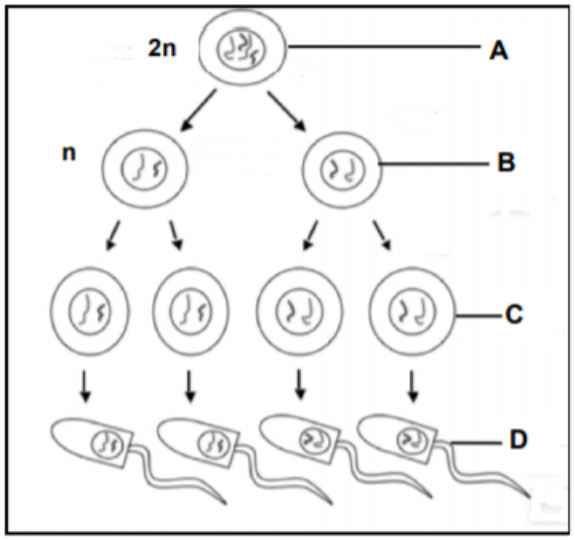
4.3 4.3.1
B vas deference √
D scrotum√
F seminal vesicle √ (3)

4.3.2
- Hypoplasia √
- Cryptochidism √
- Sperm defects √ (Any 2 x 1) (2)

4.4	The bull may appear healthy and normal but shows no interest in cows due to several factors. Name the factor that is associated with each of the following statements:		
	4.4.1	Bull is used throughout the ploughing season	(1)
	4.4.2	Unbalanced ration to bull	(1)
	4.4.3	Young bull is raised in isolation	(1)
	4.4.4	Incorrect handling and care	(1)

4.4	4.4.1	Exhaustion/Fatigue √	(1)
	4.4.2	Malnutrition √	(1)
	4.4.3	Lack of experience √	(1)
	4.4.4	Temperament √	(1)

4.3 The diagram below represents the process of spermatogenesis.



4.3.1 Refer to the above diagram and identify the type of cell division that occurs when cell **A** divides into the cells at **B**. Motivate the answer. (2)

4.3.2 State the stages of spermatogenesis represented by **C** and **D** respectively. (2)

4.3.3 Name the part of the testes where the process of spermatogenesis takes place. (1)

4.3.4 Name the part of the reproductive organ where the spermatozoa achieve mobility. (1)

4.3.5 What is the similarity between *spermatogenesis* and *oogenesis*? (1)

4.3	**The process of spermatogenesis**		
4.3.1	**Deduction on the type of cell division:** Meiosis ✓ **Reason** - genetic material is reduced into half/diploid(2n) changed into haploid (n)/reduction division ✓		(2)
4.3.2	**The stages of spermatogenesis:** **C –** Formation of the spermatids ✓ **D –** Formation of sperm cells/spermatozoa ✓		(2)
4.3.3	**Part of the testes where spermatogenesis takes place** • Tubules seminiferous ✓		(1)
4.3.4	**The organ where the spermatozoa achieve mobility** • Epididymis ✓		(1)
4.3.5	**Similarity between spermatogenesis and oogenesis** • Both occur through meiosis to produce haploid cells ✓ • Both produce gametes/sex cells ✓	(Any 1)	(1)

4.2	Although bulls produce semen and appear to be healthy and normal, the cow is unable to produce offspring.		
4.2.1	Give a term for the condition referred to above.		(1)
4.2.2	Indicate THREE causes of the condition referred to in QUESTION 4.2.1.		(3)
4.2.3	Name THREE characteristics of good quality semen that can be observed under a microscope.		(3)

4.2 **Infertility in bulls**

4.2.1 **A term for identified condition**
Infertility/sterility ✓ (1)

4.2.2 **THREE causes of infertility**
- Diseases ✓
- Infections ✓
- Congenital defects ✓
- Malnutrition ✓
- Old age/senility ✓
- High environmental temperatures ✓ (Any 3) (3)

4.2.3 **THREE characteristics of a good quality semen**
- Mobility/live sperm cells ✓
- Concentration of sperm cells ✓
- Less than 20%/few abnormalities/defects ✓ (3)

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

4.6 **THREE causes for lack of libido**
- Immaturity ✓
- Inexperience ✓
- Diseases ✓
- Underfeeding/overfeeding/malnutrition ✓
- Old age/senility ✓
- Overwork/exhaustion/over exertion ✓
- Improper handling/stress ✓
- Lack of testosterone ✓
- Temperament ✓
- Environment ✓ (Any 3) (3)

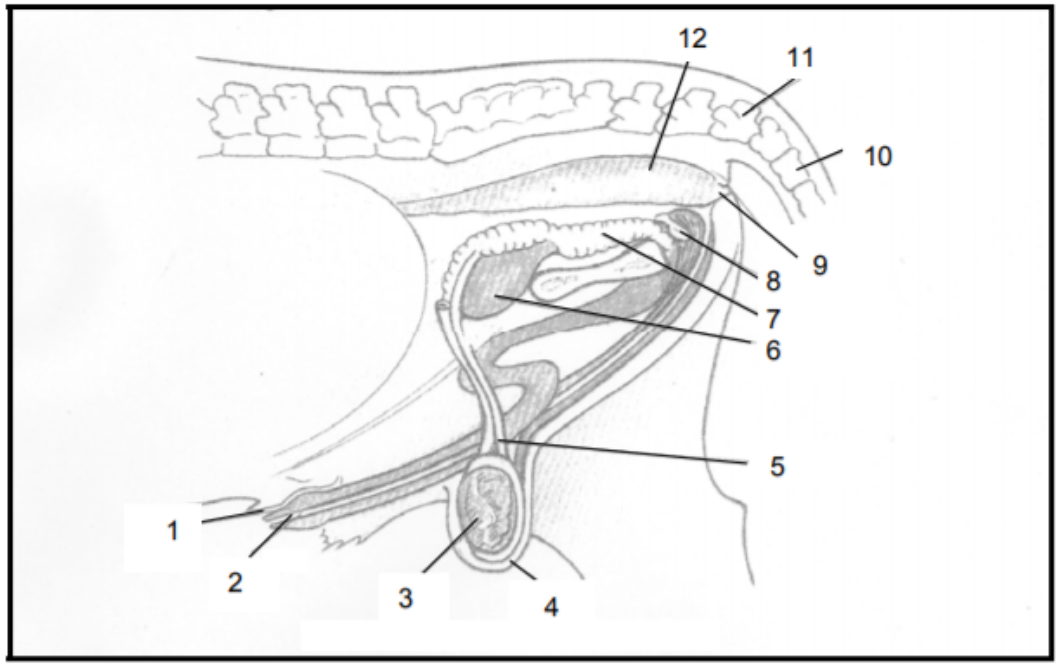
4.3	During the process of oogenesis and spermatogenesis, the cells undergo mitosis and meiosis, but these divisions give rise to different cells. Differentiate between oogenesis and spermatogenesis with regard to the following:		
	4.3.1	Cells formed during mitosis	(2)
	4.3.2	Cells formed during meiosis 2	(2)
	4.3.3	Organs where they are formed	(2)

4.3	4.3.1	**Oogenesis** **Spermatogenesis**	primary oocytes √ primary spermatocytes √	(2)
	4.3.2	**Oogenesis** **Spermatogenesis**	ootids √ primary spermatids √	(2)
	4.3.3	**Oogenesis** **Spermatogenesis**	ovary √ testicles/testes √	(2)

4.4	After the process of spermatogenesis has been completed, sperms move through various primary and secondary organs until they reach the mating organ. Indicate the organ responsible for each of the following functions.		
	4.4.1	Transports sperms from the epididymis to the urethra	(1)
	4.4.2	Secretes a sticky alkaline mucus that gives semen a characteristic smell	(1)
	4.4.3	Secretes a buffer that protects sperms against pH changes	(1)

4.4	4.4.1	Vas deferens/seminal tube √	(1)
	4.4.2	Prostate gland √	(1)
	4.4.3	Epididymis √	(1)

QUESTIONS 1.1.4 to 1.1.5 relate to the illustration below.



1.1.4 The primary reproductive organ of the bull in the diagram above is numbered …

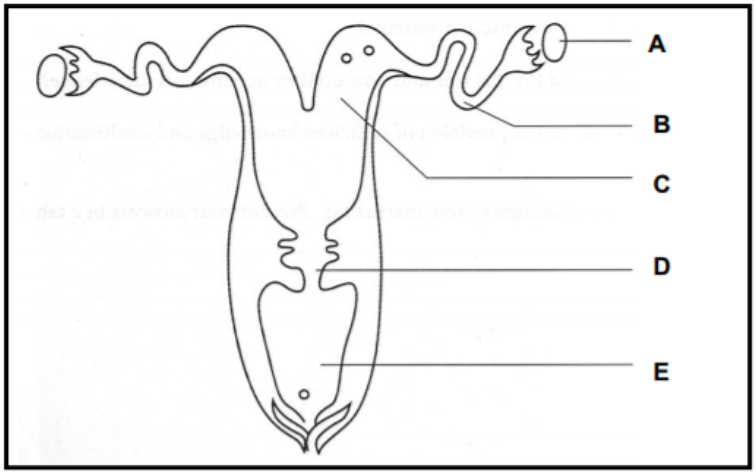
A 1.
B 3.
C 5.
D 7.

1.1.5 The reproductive organ mentioned in QUESTION 1.1.4 is called the primary reproductive organ because it …

A produces the carrier fluid for spermatozoa.
B produces spermatozoa and testosterone.
C is the largest of the sex organs.
D secretes all the sex hormones.

COW ORGANS

4.1 The diagram below illustrates the female sex organs of a cow.



4.1.1 Identify TWO labels (**A**–**E**) that represent secondary sex organs from the illustrated diagram above. (2)

4.1.2 Indicate the labelled part (**A**–**E**) where the following will take place:

(a) Site of fertilisation (1)

(b) Prevention of microbial infection of the uterus during pregnancy (1)

4.1.3 Briefly describe the function of the part labelled **D** in the diagram above. (1)

4.1.4 Identify the part of the fallopian tube that is responsible for catching the released ovum and name TWO adaptations for this purpose. (3)

4.1.1 **Secondary sex organs**

- **C**/Uterus horn/ uterus✓
- **B**/Fallopian tubes / oviduct/ egg tube ✓
- **D**/Cervix / cervical canal/uterus neck ✓
- **E**/Vagina ✓ (Any 2) (2)

4.1.2 **Labelled parts**

(a) **B** fallopian tube/oviduct/ampulla ✓ (1)
(b) **D** plug at the mouth of the cervix✓ (1)

Functions

4.1.3 Protection/closing of the foetus/uterus during pregnancy/canal for entry of sperm/mucous plug ✓ (1)

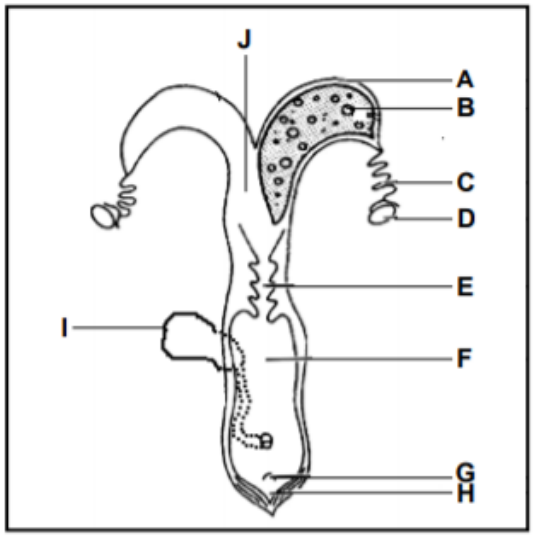
4.1.4 **Part responsible for catching ovum**

Infundibulum/finger-like projections/ fimbria /funnel shaped structure ✓ (1)

Adaptation of the fallopian tube

- Positions itself around the ovary to ensure ova does not fall/funnel shaped✓
- Guides ovulated ova into the oviduct ✓
- Vibrating cilia allow movement ✓
- Ensuring that the ova moves in the right direction✓ (Any 2) (2)

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



4.1.1 Identify the parts of the reproductive system labelled **A**, **C**, **E** and **F**. (4)

4.1.2 Write down the letter (A–J) of the part in the diagram above that is associated with EACH of the following:

(a) Serves as a birth canal (1)

(b) Site of fertilisation (1)

(c) Organ not directly involved in reproduction (1)

(d) Deposition of semen during artificial insemination (1)

4.1.3 Explain how the caruncles represented by **B** contribute to the implantation of the embryo. (2)

4.1 **Reproductive organs of the cow**

4.1.1 **Reproductive parts**

A – uterine horn ✓
C – fallopian tube/oviduct ✓
E – cervix ✓
F – vagina ✓ (4)

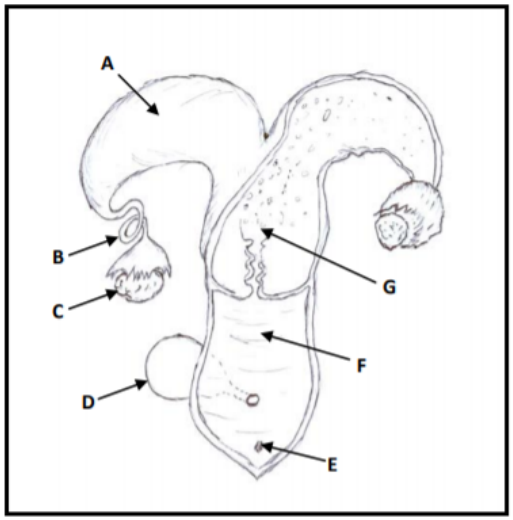
4.1.2 **Linking of parts**

(a) F ✓
(b) C ✓
(c) I ✓
(d) J ✓ (4)

4.1.3 **Role of caruncles**

- Contain nodules ✓
- That provide for implantation of embryo ✓ (2)

4.1 The diagram below represents the female reproductive system.



4.1.1 Identify parts **A**, **B**, **C** and **F**. (4)

4.1.2 Indicate the letter (A–G) and the name of the part that is usually plugged with alkaline mucus during pregnancy. (2)

4.1 **Female reproductive organs**

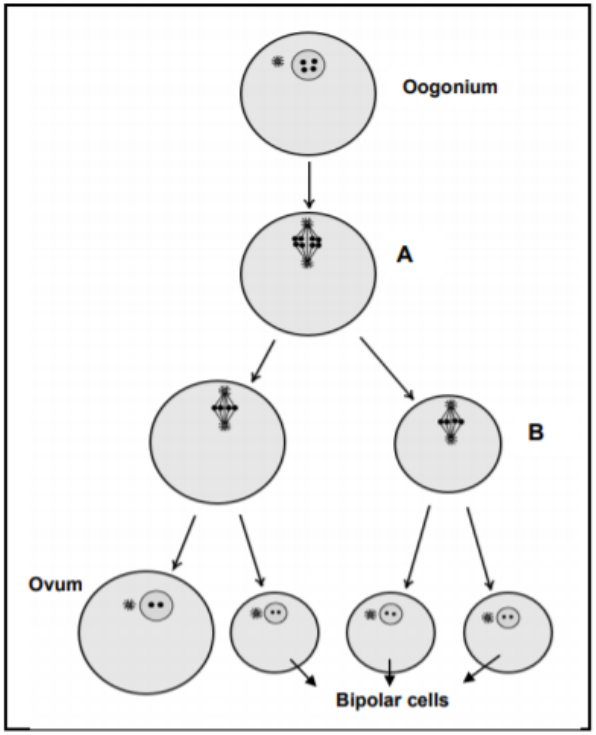
4.1.1 **Identification of parts of a female animal**

- A - Uterine horn ✓
- B - Fallopian tube/oviduct ✓
- C - Ovary ✓
- F - Vagina ✓ (4)

4.1.2 **Letter and name with alkaline plug**

- G ✓
- Cervix ✓ (2)

4.5 The diagram below represents a process that takes place in the reproductive system of a cow.



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

4.5.2 Name the type of cell division responsible for the formation of cell **A**. (1)

4.5.3 Give a reason why cells **B** divide through meiosis. (1)

4.5.4 Indicate the end products of division of the following processes:

(a) Oogenesis (1)

(b) Spermatogenesis (1)

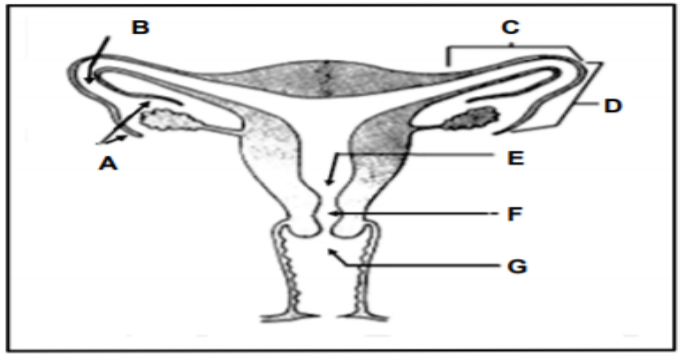
4.5.5 Name the organ where you will find the following:

(a) Spermatogonium (1)

(b) Oogonium (1)

4.5.1	**Type of process** Oogenesis/ovigenesis ✓	(1)
4.5.2	**Type of cell division** Mitosis ✓	(1)
4.5.3	**Explanation for meiotic division** To form haploid cells/gametes ✓	(1)
4.5.4	**End products of division of oogenesis and spermatogenesis** **(a)** Ova/egg cells ✓	(1)
	(b) Spermatozoa/sperm cells ✓	(1)
4.5.5	**The organ where the following are found** **(a)** Testis ✓	(1)
	(b) Ovary ✓	(1)

4.2 The diagram below represents the female reproductive system.



4.2.1 Write down the letter (A–G) of the structure where semen will be deposited:

(a) Under natural mating conditions (1)

(b) With artificial insemination (AI) (1)

4.2.2 Write down the letter (A–G) and the name of the structure that:

(a) Captures the ripe follicle after ovulation (2)

(b) Serves as a site for fertilisation (2)

4.2.3 Explain the term *ovulation*. (2)

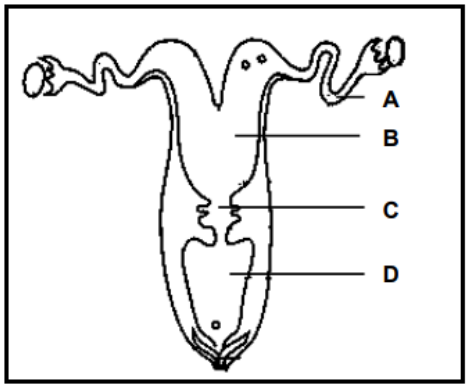
4.2 **The female reproductive tract**

4.2.1 **Deposition of semen:**
(a) G ✓ (1)
(b) F/E ✓ (1)

4.2.2 **Identification of the structure collecting the ripe follicle:**
(a) A ✓ Infundibulum ✓ (2)
(b) B ✓ Ampulla ✓ (2)

4.2.3 **Concept of ovulation**
- Process whereby the membrane containing the ripe follicle bursts with the help of LH and ✓
- the ripe ovum is released into the infundibulum ✓ (2)

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



Write down only the letter (A–D) of the part where EACH of the following occurs:

4.1.1 Fertilisation (1)

4.1.2 Implantation of the fertilised ovum (1)

4.1.3 Deposition of semen by a male organ (1)

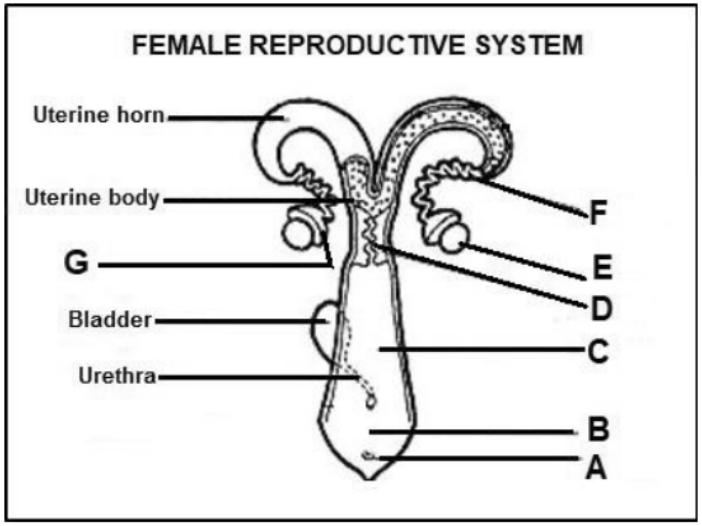
4.1 **Reproductive system of a cow**

4.1.1 A ✓ (1)

4.1.2 B ✓ (1)

4.1.3 D ✓ (1)

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



4.1.1 Identify the parts labelled **G**, **F** and **B** in the DIAGRAM above. (3)

4.1.2 Match the functions listed below with a letter (**A–K**) in the diagram above:

(a) Produce female gametes and hormones
(b) Organ of copulation
(c) Physical barrier to the uterus, secretes mucous that creates a cervical plug during pregnancy (3)

4.1.3 Provide the name and letter (**A–K**) of the female organ that becomes erects like a penis during oestrus. (2)

4.1 **The reproductive system of a cow**

4.1.1 **Identification of parts**

- **G:** Infundibulum ✓
- **F:** Oviduct / Fallopian tubes ✓
- **B:** Vulva ✓

4.1.2 **Matching functions with the letter**

(a) E ✓
(b) C / B ✓
(c) D ✓

4.1.3 **Name and letter of the part**
Clitoris: ✓ A ✓

4.1 The diagrams below show the organs in the reproductive system of a bull and a cow.

DIAGRAM 1

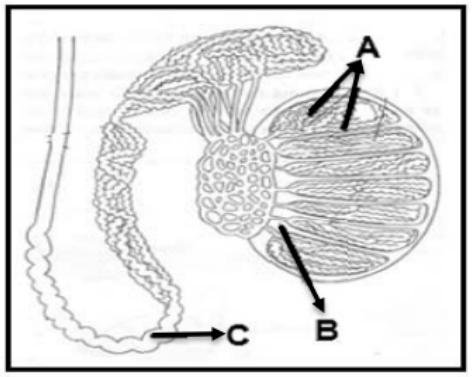
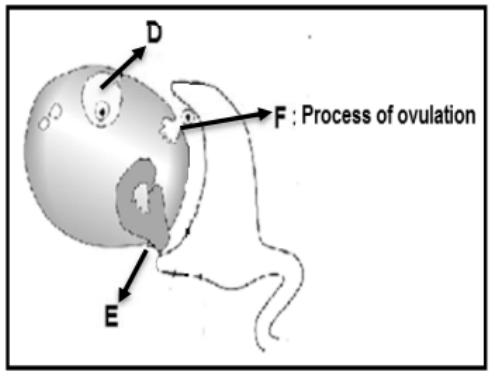


DIAGRAM 2



4.1.1 Identify the letter representing the part where the following occurs in **Diagram 1** and **Diagram 2**:

(a) Gametes are formed in **Diagram 1** and **Diagram 2** (2)

(b) Acts as a temperature control mechanism in **Diagram 1** (1)

(c) Secretion of progesterone in **Diagram 2** (1)

(d) Production of testosterone in **Diagram 1** (1)

4.1.2 Name the congenital defect common in both organs in the diagrams above that may lead to sterility. (1)

4.1.3 Indicate TWO hormones responsible for the process labelled **F**. (2)

4.1 **Reproductive systems**

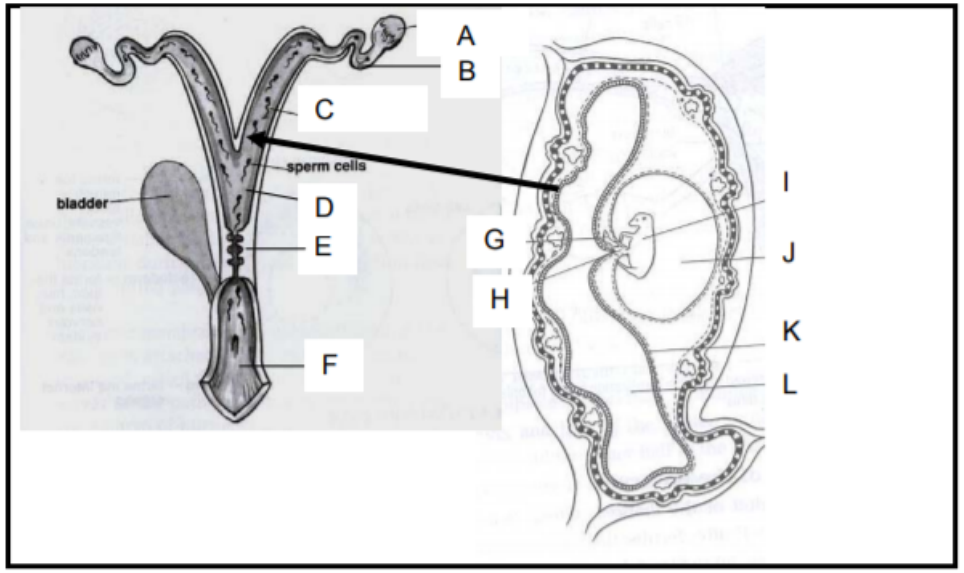
4.1.1 **Identification of the letter**

(a) **Diagram 1** – A ✓
Diagram 2 – D ✓ (2)
(b) C ✓ (1)
(c) E ✓ (1)
(d) A ✓ (1)

4.1.2 **Common congenital defect in bulls and cows causing sterility**
Hypoplasia ✓ (1)

4.1.3 **TWO hormones responsible for ovulation**
Luteinizing hormone ✓
Oestrogen hormone ✓ (2)

4.2 The diagram below represents reproductive organs and a stage in the reproduction process in cattle.



4.2.1 Indicate the correct position where the processes below occur in the female animal to have successful reproduction. Use the letter provided in the diagram above for your answer.

(a) Embryo development

(b) Fertilisation

(c) Ovulation

(d) Follicle development (4)

SYNCHRONISATION OF OESTRUS

4.3 Farm animals should be sexually mature and produce healthy and viable gametes. This should be followed up with the process of mating when the female animals are on heat.

4.3.1 State the FIVE stages of mating in sequential order. (5)

4.3.2 List THREE factors which regulate the mating behaviour of bulls. (3)

4.3 **The process of mating**

4.3.1 **FIVE stages of mating in sequential order**

- Courtship/Sexual attraction ✓
- Mounting ✓
- Copulation/intromission ✓
- Ejaculation ✓
- Dismounting ✓ (5)

4.3.2 **THREE factors regulating mating behavior among bulls**

- Genetic make-up ✓
- Environmental factors ✓
- Physiological factors ✓
- Health ✓
- Experience ✓ (Any 3) (3)

4.2	A farmer can save time and labour cost by bringing all the cows on heat at approximately the same time.		
	4.2.1	Identify the process in the scenario above.	(1)
	4.2.2	Name ONE hormone that will induce the process identified in QUESTION 4.2.1.	(1)
	4.2.3	State TWO financial implications of the process identified in QUESTION 4.2.1.	(2)

4.2	**Synchronisation**		
	4.2.1	**Identify process** Synchronisation of oestrus ✓	(1)
	4.2.2	**ONE hormone inducing the process** • Prostaglandin ✓ • Synthetic progesterone/Progestin/Oestradiol ✓ • Co-Synch oestrus synchronization/GnRH ✓ • MGA/Melengestrol acetate ✓ (Any 1)	(1)
	4.2.3	**Financial implication of synchronisation** • High costs for labour/hormone treatments ✓ • High management inputs/costs ✓	(2)

4.3	Re-arrange, in sequential order, the following statements (A–E) relating to the stages of mating. Write down only the letter of the statement.		
	A	Penetration of the vagina.	(1)
	B	Male animal jumps off.	(1)
	C	Bull shows interest in cows due to increased level of pheromones.	(1)
	D	Male animal stands on his hind legs with his chest on the female animal's rump.	(1)
	E	Bull releases sperm.	(1)

4.3	**Re-arranging the statements in sequential order**	
	1. C ✓	(1)
	2. D ✓	(1)
	3. A ✓	(1)
	4. E ✓	(1)
	5. B ✓	(1)

4.5 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)

4.5.1 Identify the process above. (1)

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

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

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

4.5.1 **Identification of the process**
Synchronisation of oestrus ✔ (1)

4.5.2 **TWO disadvantages of a synchronisation schedule in cattle**
- Poor nutrition/body condition/health will affect the process negatively ✔
- Needs good/expensive facilities ✔
- Labour/time intensive ✔
- Involves skilled management and technologies ✔ (Any 2) (2)

4.5.3 **TWO techniques used in the synchronisation of female animals**
- Synthetic progesterone/progestin/oestradiol ✔
- Co-Synch/gonadotropin/co-synch synchronisation ✔
- Ear patches/implants ✔
- Vaginal insurgents ✔ (Any 2) (2)

4.5.4 **Indication of the time (day) when the cows will be inseminated**
Day 35 – 40 ✔ (1)

4.3 Farmers or breeders can increase the herd rapidly by bringing a group of cows into oestrus at the same time so that they calve simultaneously.

4.3.1 Give the term referring to the process stated above. (1)

4.3.2 Different techniques are used to do the process stated in QUESTION 4.3.1. Name any TWO of these techniques. (2)

4.3.3 State TWO disadvantages of the process in QUESTION 4.3.1 for the breeder. (2)

4.3.4 Name TWO advantages of the process in QUESTION 4.3.1 for the breeder (2)

4.3.1 **Term referring to the process**
Synchronisation of oestrus √ (1)

4.3.2 **TWO techniques of synchronising oestrus**
- Inject prostagladin √
- Inject/ear implanting progesterone √
- MGA and PG given in a feed √
- Controlled internal drug release (CIDR) √
- Gonadotrophin-releasing hormone (GnRH) (Any 2 x 1) (2)

4.3.3 **TWO disadvantages of synchronisation**
- Labour intensive √
- It is expensive √
- High level of management is needed √
- Need good handling facilities √
- Pregnancy testing needs to be done regularly √ (Any 2 x 1) (2)

4.3 The data below shows reproductive processes in sheep.

A Artificial insemination (AI)
B Lambing
C Synchronisation of oestrus
D Conception
E Pregnancy

4.3.1 Arrange the processes above in the correct chronological order. Write down only the letters (A–E) next to the question number (4.3.1) in the ANSWER BOOK. (5)

4.3.2 Define the term *synchronisation of oestrus*. (2)

4.3 **Reproductive processes in sheep**

4.3.1 **The correct chronological order**

C ✓ (1)
A ✓ (1)
D ✓ (1)
E ✓ (1)
B ✓ (1)

4.3.2 **Definition of synchronisation**

Changing the oestrus cycle in a group of ewes/female animals ✓ so that they come to oestrus approximately at the same time ✓ (2)

4.4 The list below represents stages of mating or copulation:

- Gaining intromission into the vagina
- Ejaculation of semen into vagina
- Mounting
- Erection of the penis

Re-arrange the stages of mating presented in the list above into its chronological order. (4)

4.4 The list below represents stages of mating or copulation:

- Gaining intromission into the vagina
- Ejaculation of semen into vagina
- Mounting
- Erection of the penis

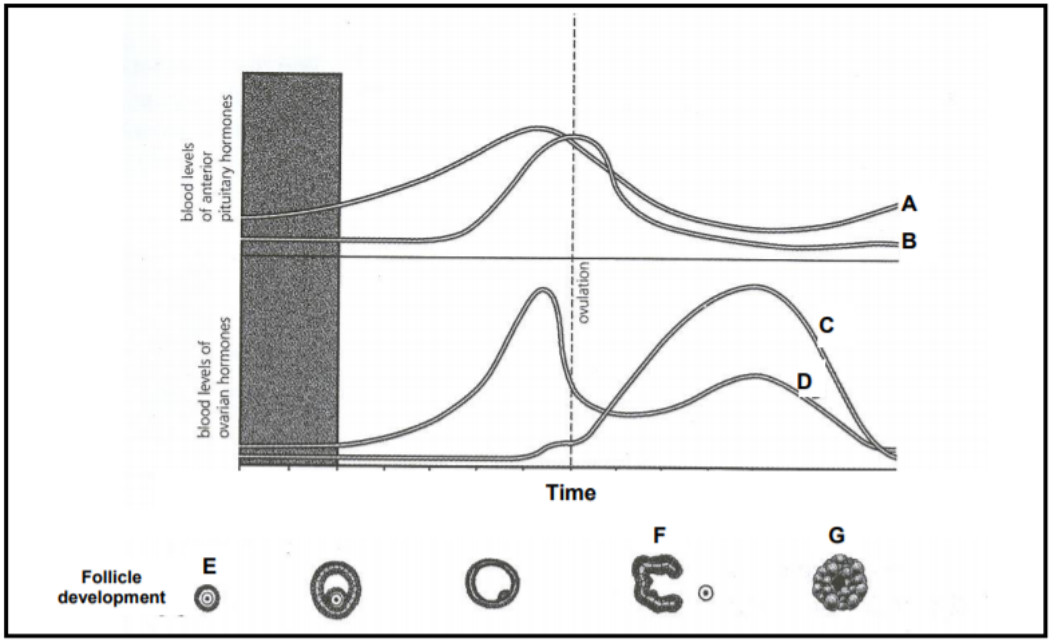
Re-arrange the stages of mating presented in the list above into its chronological order. (4)

OESTUS AND OESTRUS CYCLE

Oestrus and oestrus cycle

- *The concept*: oestrus/heat period
- The female sex hormones and their respective functions
- The periods/stages/phases of the oestrus cycle in cows
- The noticeable signs/characteristics of oestrus in cows
- The practical methods dairy farmers can adopt to assist in identifying cows on heat

4.2 The illustrations below represent the hormone levels in a farm animal during the oestrus period.



4.2.1 Name the hormones which are represented by the curves marked **A** and **C** in the graphs above. (2)

4.2.2 Name the main function in the oestrus cycle of the hormone marked **D** in the graph above. (1)

4.2.3 Name the process that occurs at **F** in the diagram above. (1)

4.2.4 Name the source where the hormone, indicated as **C** in the graph above, is secreted. (1)

4.2.5 Name a hormone that you will use to make the female animal superovulate to produce many ova. (1)

4.2 Hormone levels of farm animals

4.2.1 A – FSH ✓
C – progesterone ✓

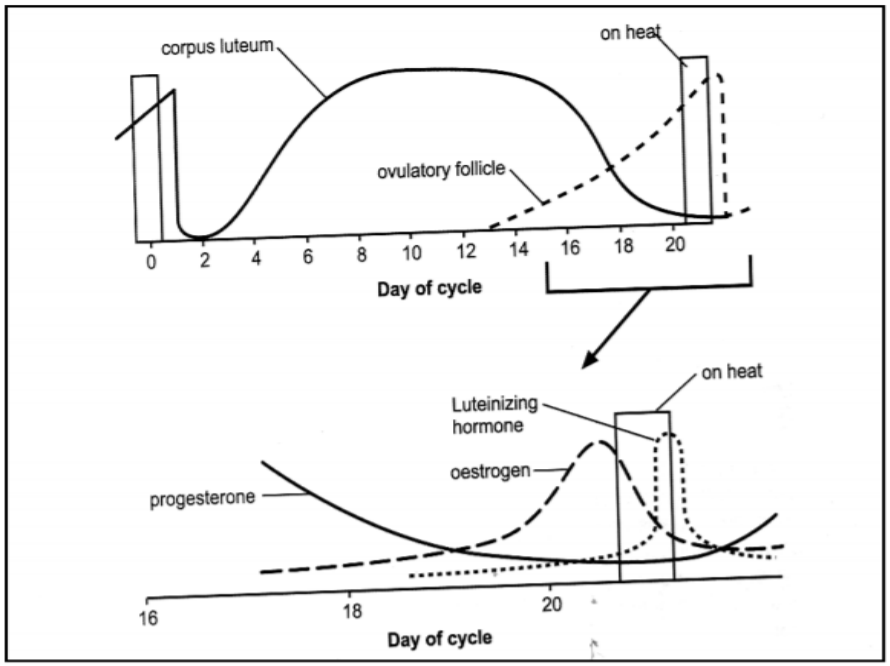
4.2.2 Symptoms of oestrus ✓

4.2.3 Ovulation/rupturing of the follicle/release of ovum ✓

4.2.4 The corpus luteum secrete the hormone progesterone

4.2.5 FSH ✓

4.2 The graphs below illustrate the hormonal changes in a typical oestrus cycle of a farm animal.



4.2.1 Identify the day when ovulation will take place. (1)

4.2.2 Indicate TWO hormones responsible for the process of ovulation. (2)

4.2.3 State TWO functions of each of the following hormones at their peak levels:

(a) Luteinising hormone (2)

(b) Oestrogen (2)

4.2.4 Name the change that occurs in the progesterone levels after successful mating. Explain the TWO effects of this change. (3)

4.2.1 **Start of ovulation**
Values between **day 20 and 21** ✓ (1)

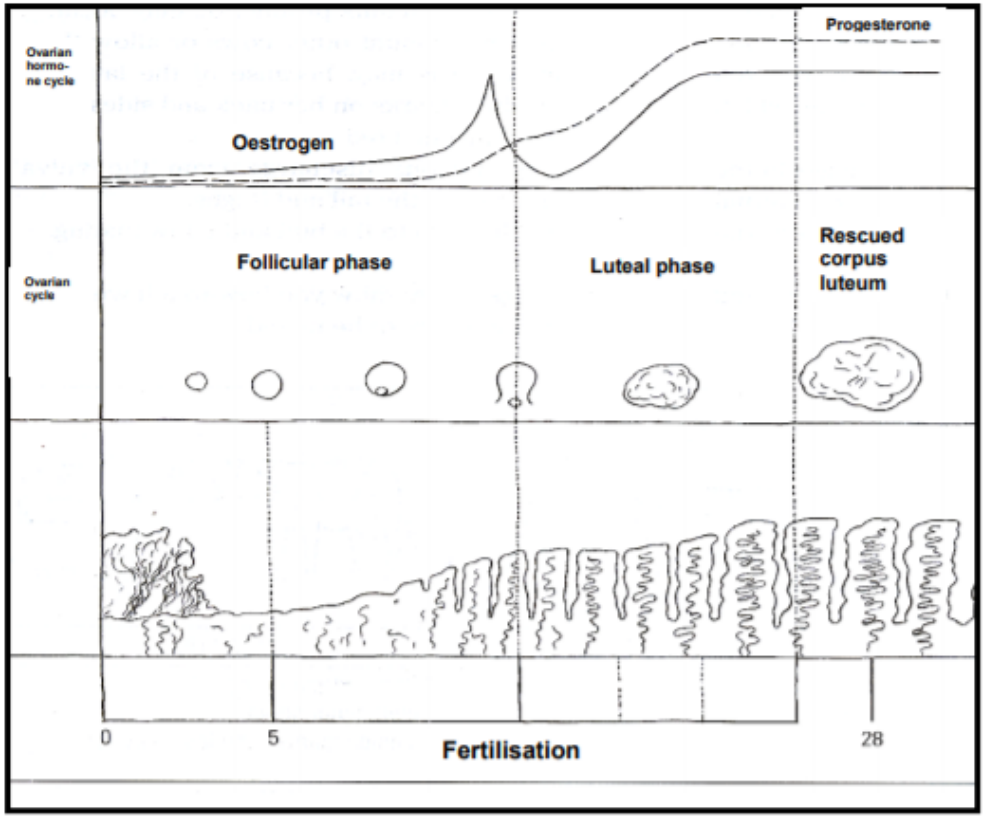
4.2.2 **Hormones responsible for ovulation**
- Oestrogen ✓
- Luteinizing hormone (LH) ✓ (2)

4.2.3 **Hormone responsible**
(a) Luteinizing hormone
- LH released by the brain causes the ovary to release the ova / together with oestrogen causes the follicles to burst to release the ova ✓
- Responsible of the formation of corpus luteum ✓
- Tightens infundibulum around ovary ✓ (Any 2) (2)

(b) Oestrogen
- Thickens/preparation the lining of the uterus for the fertilized egg /enhances the thickness of the uterus wall✓
- Responsible for heat symptoms ✓
- Stimulates the graafian follicle to release the ovum/ovulation✓
- Stimulates brain to release LH ✓
- Delays the secretion of FSH ✓
- Increases blood supply to uterus✓
- Prevents bacterial infection of the uterus when cervix is open✓
- Relaxes the walls of the uterus ✓ (Any 2) (2)

4.2.4 **Changes in progesterone levels**
Progesterone levels increase/becomes higher ✓ (1)
Effects:
- Prepares the uterine wall (thickens) for the implantation of the fertilized ovum/maintaining pregnancy✓
- Delays the secretion of FSH ✓
- Inhibits the maturation of the graafian follicle ✓
- Prevents oestrus/ovulation ✓ (Any 2) (2)

4.1 The diagram below illustrates hormone release during the oestrus cycle.



4.1.1 Describe THREE changes that the follicle undergoes during the oestrus cycle by referring to the diagram above. (3)

4.1.2 Name a function of the following hormones in the oestrus cycle:

(a) Progesterone (1)
(b) Oestrogen (1)

4.1 **Oestrus cycle**

4.1.1 **THREE changes that take place with the follicle during the oestrus**

- Follicle becomes bigger/grows/enlarged ✔
- Ovum develops in the follicle ✔
- Ovulation takes place/ovum is released ✔
- Corpus Luteum develops ✔ (Any 3) (3)

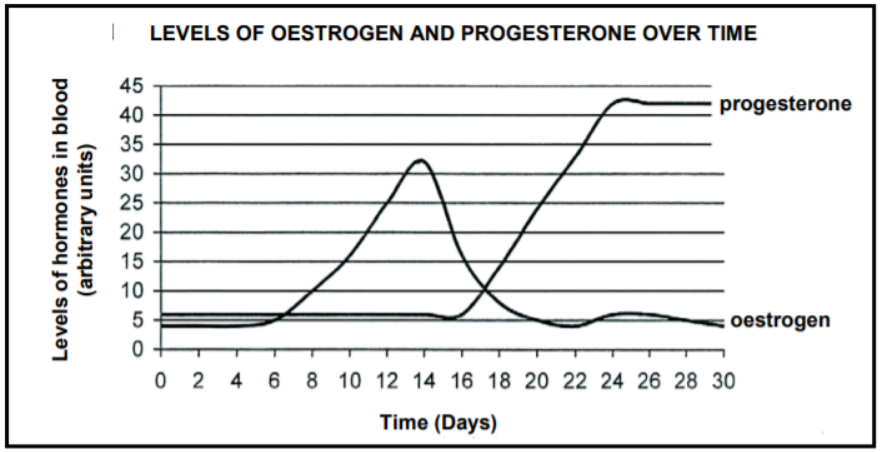
4.1.2 **(a) Progesterone**

- Prepare the uterus for the reception of the fertilised ovum✔ Supporting the attachment of the embryo✔
- Maintain pregnancy✔ (Any 1) (1)

(b) Oestrogen

- Characteristics of oestrus✔
- Increased blood supply to uterus to prepare it for the reception of the fertilised ovum✔ (Any 1) (1)

4.2 The graph below shows the levels of two hormones, namely oestrogen and progesterone in a cow that became pregnant.



4.2.1 Identify the times when the levels of oestrogen and progesterone are equal. (2)

4.2.2 Indicate the level of oestrogen in the blood on day 14. (1)

4.2.3 Give evidence from the graph that suggests that an ovum was fertilised. (2)

4.2.4 Explain TWO effects that the peak period of oestrogen has on the animal. (2)

4.2.5 What would happen to the corpus luteum if this cow was not pregnant? (1)

4.2 **Progesterone and oestrogen**

4.2.1 Day 7✓ & day 17✓ (2)

4.2.2 30 – 33 units ✓ (1)

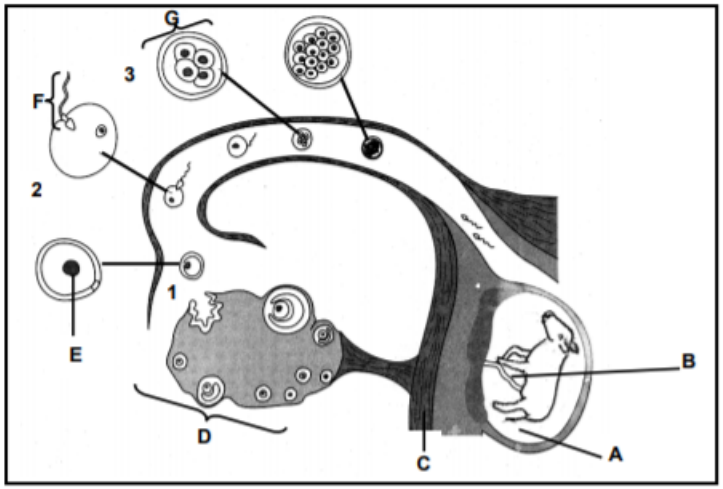
4.2.3 **Progesterone**
Sharp increase in the level of progesterone✓
Sharp decrease in levels of oestrogen✓ (2)

4.2.4 **TWO effects of oestrogen on the animal at peak period**

- Thickens the lining of the uterus prepares the uterus for the implantation of the fertilised ovum/increases blood supply to the uterus✓
- Relaxes the muscles of the cervix✓
- Delays the secretion of FSH at the end of oestrus✓
- Stimulates the gland in the brain to release LH✓
- Stimulates the process of ovulation through the release of LH✓
- Leads to the display of signs of oestrus✓
- Prevents bacterial infection of the uterus✓ (Any 2) (2)

4.2.5 The corpus luteum will degenerate/burst/be resorbed/be broken down✓ (1)

4.1 The diagram below illustrates part of the reproductive system. Structures **B** to **G** and processes **1** to **3** occur in the Fallopian tube and uterus.



4.1.1 Identify the processes taking place at **1**, **2** and **3**. (3)

4.1.2 Name TWO functions of fluid **A**. (2)

4.1.3 State the main function of structure **B**. (2)

4.1.4 Indicate the hormone responsible for the process taking place at **1**. (1)

4.1.5 Describe how part **F** is adapted to enable it to enter the egg cell. (2)

4.1.1
1. Ovulation✓
2. Fertilisation✓
3. Mitosis/cell division✓ (3)

4.1.2 **Function of amniotic fluid**
- Protects the embryo from shocks✓
- Suspends the embryo✓
- Prevent the embryo from drying out✓
- Make calving easier/lubricates the birth canal during calving✓ (Any 2) (2)

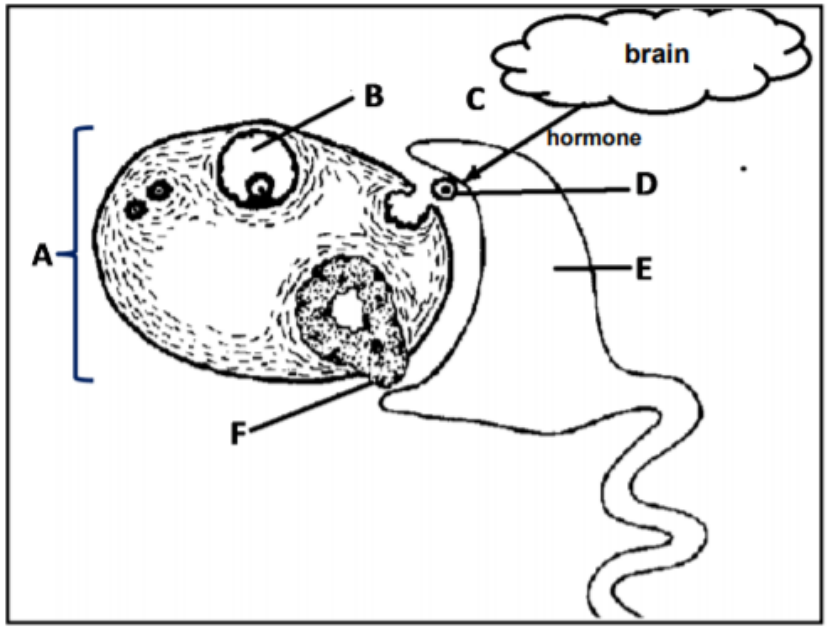
4.1.3 **Function of structure B**
- Passage for oxygen and nutrients✓
- from the maternal blood✓
  or
- Passage for waste products✓
- from the embryo✓ (2)

4.1.4 Luteinising hormone(LH)✓ (1)

4.1.5 **Adaptation of part F**
- Contains an acrosome with the enzyme✓
- Enzyme can dissolve the embryo wall✓
- Facilitates egg cell penetration as it moves forward/head part✓

(Any 2) (2)

4.2 The diagram below shows a structure in the female reproductive system of a farm animal.



4.2.1 Name structures **A**, **B** and **E**. (3)

4.2.2 Name the hormone associated with each of the following functions:

(a) Stimulating the development of structure **B** (1)

(b) Stimulating process **D** (1)

(c) Characterises the visible signs of oestrus (1)

(d) Secreted by structure **F** (1)

4.2.3 Describe how structure **E** is adapted to successfully capture the ovum. (2)

4.2.1 **Names represented by letters**

A - Ovary ✓
B - Graafian follicle✓
E - Infundibulum✓ (3)

4.2.2 **Hormones**

(a) Follicle stimulating hormone/FSH ✓ (1)
(b) Oestrogen/LH (Luteinising hormone) ✓ (1)
(c) Oestrogen ✓ (1)
(d) Progesterone ✓ (1)

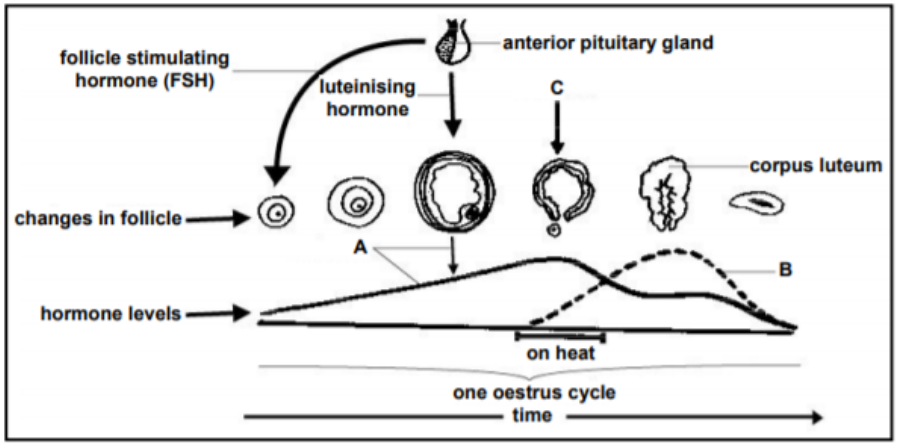
4.2.3 **Adaptability of infundibulum**

- Contains hair-like structures/cilia ✓
- for movement of the ova ✓

Or

- Wider at the edge/bell shaped/ funnel shape ✓
- adapted for holding/capturing the ova ✓ (2)

4.2 The schematic representation below indicates the sequence of hormonal changes that occur during the oestrus cycle and some structures that are involved.



4.2.1 Identify hormone **A** and hormone **B**. (2)

4.2.2 Identify and briefly describe process **C** in the schematic representation above. (2)

4.2.3 State FOUR visible signs that the cow will display when hormone **A** is at its peak. (4)

4.2.4 What is the main function of the following hormones in the schematic representation above:

(a) FSH (1)

(b) LH (1)

4.2 **Sequence of hormonal changes**

4.2.1 **Identify the labels**
A - oestrogen ✓
B - progesterone ✓ (2)

4.2.2 **Process and role of C**
- Ovulation ✓ (1)

Role
- Release of ovum ✓ (1)

4.2.3 **Visible signs of oestrus**
- Cow lows often ✓
- It is restless ✓
- Arches its back from time to time ✓
- Swelling and reddening of vulva ✓
- Secretion of slimy mucus through the vulva ✓
- Mounts other cows ✓
- Allows mating ✓
- Scratch marks on the back✓
- Saliva/mud/soil/food particles on the back ✓ (Any 4) (4)

4.2.4 **Functions of the hormones**
(a) **FSH** - Stimulates the development/enlargement of the follicle ✓ (1)
(b) **LH** - Stimulates the bursting of the follicle ✓ (1)

4.2 The data below represents hormone levels during the oestrus cycle.

DAYS	PROGESTERONE LEVEL CONCENTRATION (mg/mℓ)	OESTROGEN LEVEL CONCENTRATION (mg/mℓ)
0	3	2
4	3	2
8	32	2
12	32	2
16	32	2
20	3	30
24	3	2

4.2.1 Draw a line graph to illustrate the levels of progesterone and oestrogen on different days during the oestrus cycle. (6)

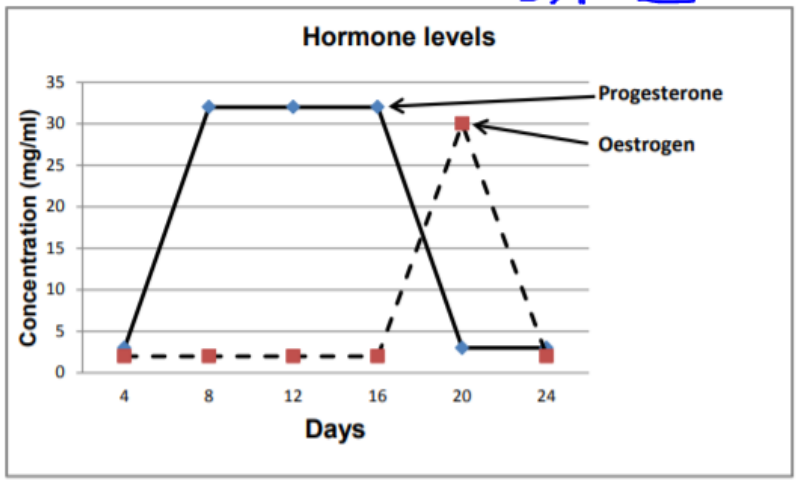
4.2.2 Suggest the role of progesterone from day 8 to day 16. (1)

4.2.3 Deduce from the data above the day when the follicles will be fully developed. (1)

4.2.4 Motivate the answer to QUESTION 4.2.3 by referring to the graph. (1)

4.2 **Levels of hormones during oestrus cycle**

4.2.1 **Graph of the hormone levels** IN DAYS



Criteria/rubric/marking guidelines

- Correct heading ✓
- Y-axis – correct calibrations and labelled (Concentration) ✓
- X-axis – correct calibrations and labelled (Days) ✓
- Correct unit ✓
- Accuracy ✓
- Line graph ✓ (6)

4.2.2 **Role of progesterone**
Inhibits/suppresses the secretion/functioning of oestrogen ✓ (1)

4.2.3 **Day when follicles will be fully developed**
Day 20 ✓ (1)

4.2.4 **Motivation**
Oestrogen is at its highest level/30mg/ml ✓
Or
Progesterone is at its lowest levels/3mg/ml ✓ (1)

4.2 Cows normally allow mating when they are in oestrus.

4.2.1 Define the term *oestrus*. (2)

4.2.2 State THREE visible signs of oestrus in cows. (3)

4.2.3 Indicate THREE practical methods a farmer can use to assist with the identification of cows on heat. (3)

4.2 **Oestrus**

4.2.1 **Oestrus**

- It is a period when non pregnant female animals✓
- are receptive to male animals/allow mating✓ (2)

4.2.2 **THREE signs of oestrus**

- Vulva is swollen/reddish✓
- Mucous discharge✓
- Cow is restless and bellows often✓
- Mounting other cows✓
- Isolation✓
- Decrease in food intake/loss of appetite✓
- Legs and flanks are muddy✓
- Allows mating✓ (Any 3) (3)

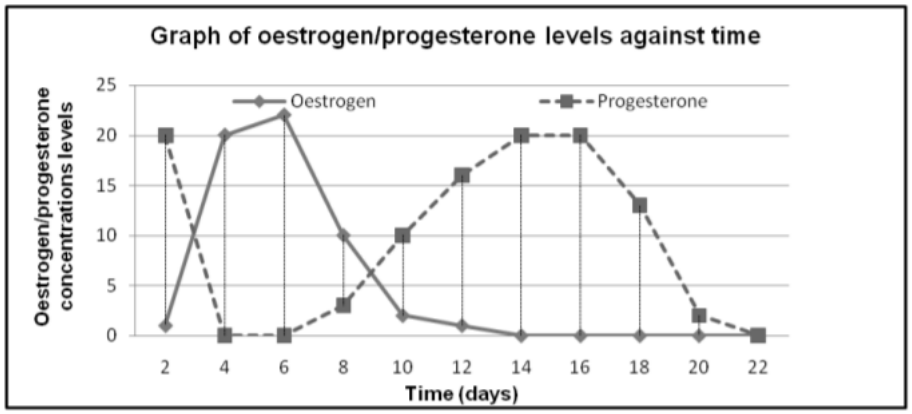
4.2.3 **THREE practical methods to identify cows on heat**

- Observation of animal behaviour✓
- Place a bull in pen near the cows✓
- Bulls marked with a chin ball marker✓
- Tail paint on tail head/tail paint markers✓
- Heat mount detectors✓ (Any 3) (3)

4.3	Farmers can use several electronic and mechanical devices to detect heat in farm animals. Identify each device described below:	
4.3.1	Placed around a cow's lower leg to record movement	(1)
4.3.2	Marker that is placed on a teaser cow to leave a mark on the back of a mounted cow	(1)
4.3.3	Placed on cows as a marker and stretches from the hip bone to where the tail begins	(1)

4.3.1	Pedometer ✓	(1)
4.3.2	Chin-ball markers ✓	(1)
4.3.3	Tail-chalking ✓	(1)

4.3 A non-pregnant cow was isolated from the rest of the herd for a research programme. Blood samples were taken daily from the cow to analyse the oestrogen and progesterone levels over a period of 22 days. The results were recorded and presented graphically as shown below.



4.3.1 Identify the most suitable day for the farmer to release the cow to mate with a bull. (1)

4.3.2 Give TWO reasons for the answer to QUESTION 4.3.1. (2)

4.3.3 Indicate the day on which ovulation might have taken place. (1)

4.3.4 Name the stage of oestrus when progesterone is at its highest level. (1)

4.3.5 Deduce whether the cow has become pregnant. Motivate the answer. (3)

4.3 **Graph of Oestrogen/Progesterone levels in a cow over 22 days**

4.3.1 **Day cow will mate with a bull**
- Day 4–6✓ (1)

4.3.2 **Motivation**
- Highest level of oestrogen✓
- Cow will be on heat✓ (2)

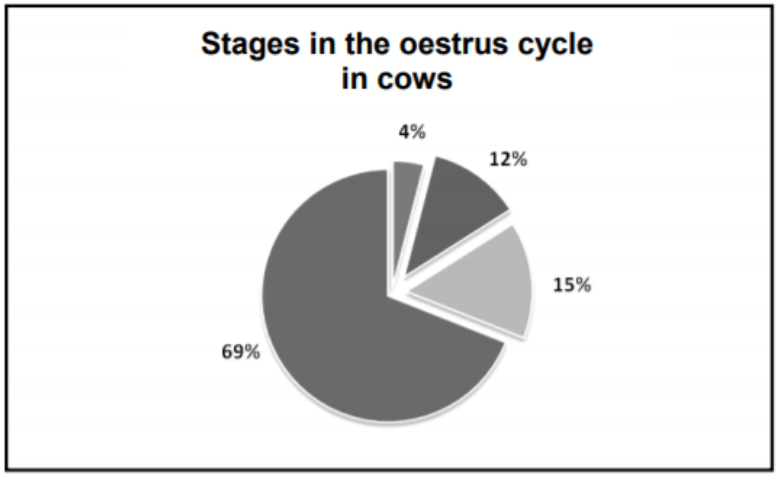
4.3.3 **Day of ovulation**
- Day 4–5✓ (1)

4.3.4 **Stage when progesterone is highest**
- Met-oestrus✓ (1)

4.3.5 **Whether cow became pregnant**
- Cow did not become pregnant✓ (1)

Motivation
- Progesterone levels declined/decreased✓
- after day 16✓ (2)

4.1 The pie chart below represents the oestrus cycle in cows.



4.1.1 Indicate the duration (in days) of the oestrus cycle in non-pregnant cows. (1)

4.1.2 Which percentage in the pie chart corresponds with the stage at which the cow will allow mating with a bull? (1)

4.1.3 Name the stage and hormone responsible for the condition in QUESTION 4.1.2. (2)

4.1.4 Indicate the hormone responsible for each of the following percentages as represented in the pie chart:

(a) 4% (1)

(b) 12% (1)

(c) 15% (1)

(d) 69% (1)

4.1.1 **Duration of the oestrus cycle in non-pregnant cows**

- 18 - 24 days ✓ (1)

4.1.2 **Percentage which corresponds with the stage at which the cow will mate with a bull**

- 4% ✓ (1)

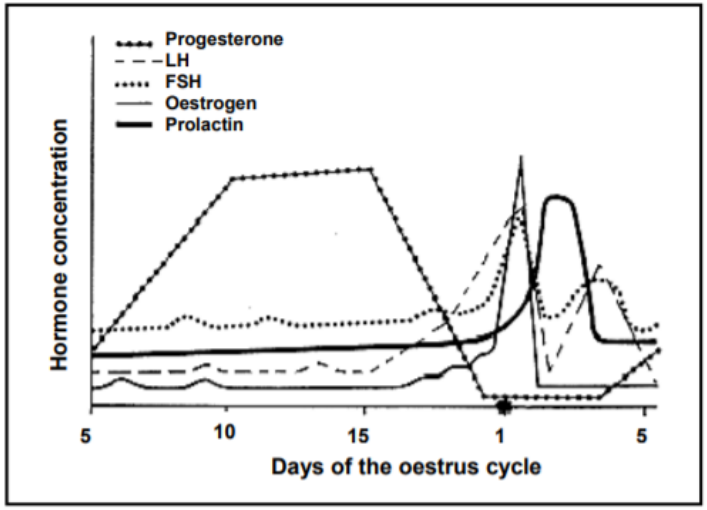
4.1.3 **Stage and hormone responsible for the condition**

- Oestrus ✓
- Oestrogen ✓ (2)

4.1.4 **The hormone responsible for each of the following percentages:**

(a) 4% - Oestrogen ✓ (1)
(b) 12% - Follicle stimulating hormone/FSH ✓ (1)
(c) 15% - Luteinising hormone/LH ✓ (1)
(d) 69% - Progesterone ✓ (1)

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



4.2.1 Define the term *oestrus cycle*. (2)

4.2.2 Identify the days during which the progesterone level is the highest. (1)

4.2.3 Give a reason for the sudden drop in the level of FSH between days 2 and 3. (1)

4.2.4 Give a reason for the increase in the level of progesterone from days 3 and 4. (2)

4.2.5 Indicate the influence of oestrogen on LH. (1)

4.2.6 Name the gland in the animal body where prolactin is produced. (1)

4.2.1 **Definition of oestrus cycle**

- Hormonally-controlled cycle of activity ✓
- of the female reproductive organs ✓

OR

- Recurring periods of oestrus ✓
- alternating with sexual rest in the matured female ✓ (Any 1) (2)

4.2.2 **Range of days in which progesterone level is the highest**

- From day 9/10 to day 15/16 (indicate any two days within the range) ✓ (1)

4.2.3 **Reason for the drop in the level of FSH between days 2 and 3**

Oestrogen levels is at its peak/high/went up ✓ (1)

4.2.4 **Reason for the increased progesterone levels on days3 and 4**

- Fertilisation has taken place ✓✓

OR

- Corpus luteum has been formed ✓✓ (Any 1) (2)

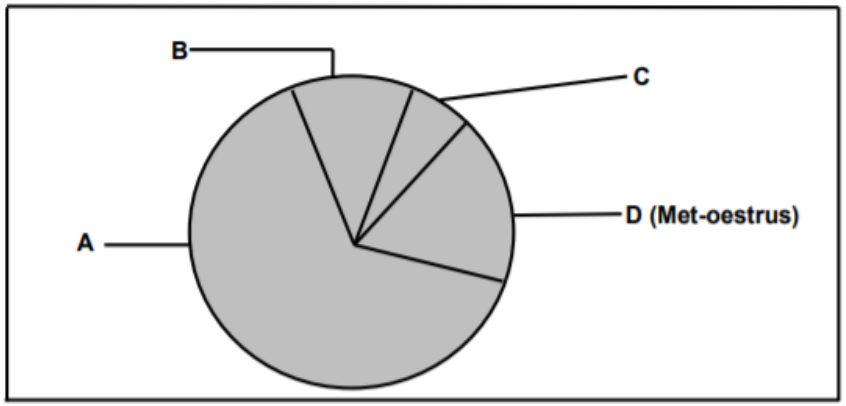
4.2.5 **Influence of oestrogen on LH**

- Oestrogen stimulates the release of LH ✓ (1)

4.2.6 **The structure where prolactin is produced**

- Pituitary gland/Hypophysis ✓ (1)

4.1 The chart below illustrates the stages of the oestrus cycle of a cow.



4.1.1 Write down the letter (A–D) of the stage where the following takes place:

(a) Increased vaginal and cervical mucus production (1)

(b) Rapid growth of follicles (1)

(c) Corpus luteum regresses if no fertilisation occurred (1)

4.1.2 The levels of two hormones change during stage **C**. Name the hormone that:

(a) Starts to decrease from a higher to a lower level (1)

(b) Reaches its highest level (1)

4.1.3 Give the role of the hormone in QUESTION 4.1.2(b). (1)

4.1.4 Name the stage of the oestrus cycle represented by **B**. (1)

The stages of the oestrus cycle in a cow

4.1.1 **Indication of oestrus cycle stages:**
(a) C ✓
(b) B ✓
(c) A ✓

4.1.2 **Hormones during stage C**
(a) Oestrogen ✓
(b) Luteinising hormone ✓

4.1.3 **The role of the hormone**
- Responsible for the rupturing of Graafian follicle ✓
- It initiates ovulation ✓

4.1.4 **Identification of the stage of the oes**
Pro-oestrus ✓

4.4 Usually, after detecting signs of oestrus in the cow, the farmer takes a bull to the cows for mating to take place.

4.4.1 Apart from visible and behavioural signs that a cow may show, name THREE devices a farmer may use to detect oestrus in a cow. (3)

4.4.2 Give FOUR reproductive hormones, in sequential order, that are produced by a cow from gestation to parturition. (4)

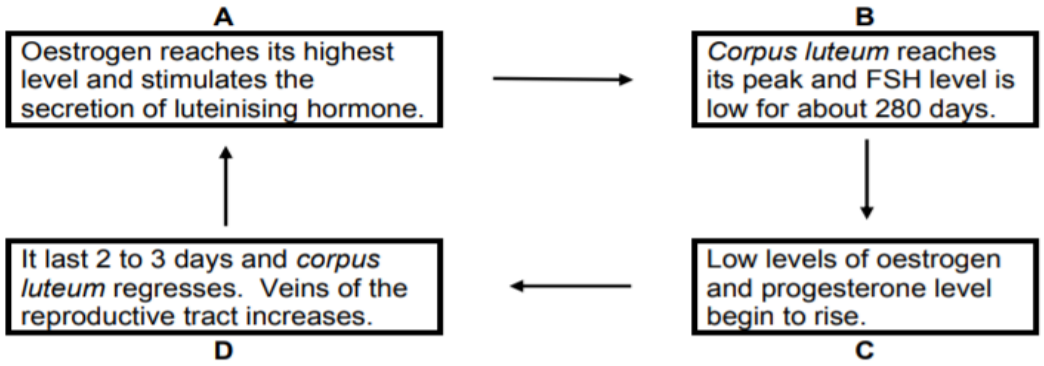
4.4.1 **Devices to detect oestrus in the cow**

- Pedometer ✓
- Chin-ball marker ✓
- Tail-chalking ✓
- Kamar heatmount detector ✓ (Any 3) (3)

4.4.2 **Sequential order of FOUR reproductive hormones that are produced by a cow**

- Progesterone ✓
- Luteotrophic hormone/LTH/prolactin ✓
- Relaxin ✓
- Oxytocin ✓ (Any 4) (4)

4.2 In female animals, hormonal and reproductive changes occur from one heat period to the next period. This occurs in phases which are marked by distinctive characteristics. Below are the characteristics applicable to each stage:



4.2.1 Match the characteristics labelled **A**, **B**, **C** and **D** with the phases of cycle. (4)

4.2.2 Indicate the letter that represent the stage where the following occurs:

(a) Graafian follicle ruptures to release the ovum (1)

(b) Ovum enters the fallopian tube for fertilisation and the ruptured follicle forms *corpus luteum* (1)

4.2 4.2.1 **A** Oestrus √
B Di-oestrus √
C Met-oestrus √
D Pro-oestrus √ (4)

4.2.2 (a) A √ (1)
(b) C √ (1)

4.2 Hormones play an important role in the reproduction cycle of farm animals.

4.2.1 Explain the term *hormone*. (2)

4.2.2 Give the main function of EACH of the following hormones:

(a) Testosterone (1)

(b) Luteinising hormone (LH) (1)

(c) Oestrogen (1)

4.2.3 Name the hormone responsible for:

(a) Maintaining the corpus luteum (1)

(b) Growth and development of the Graafian follicle (1)

4.2 **Role of hormones**

4.2.1 **Explanation of hormone**

- The chemical substance secreted by endocrine glands/ovaries/ uterus transported in the blood ✓to specific parts/target organ of the body performing specialised functions ✓ (2)

4.2.2 **Primary function of hormones**

(a) **Testosterone**

- Development of the secondary male characteristics ✓ (1)
- Enhances sexual desires✓
- Stimulate sperm production✓

(b) **Luteinising hormone (LH)**

- Rapture the membrane of the follicle during ovulation ✓
- Tightening the infundibulum around the ovary ✓
- Stimulates secretion of progesterone✓
- Maturation of the oocytes✓
- Formation of the corpus luteum ✓ (Any 1) (1)

(c) **Oestrogen**

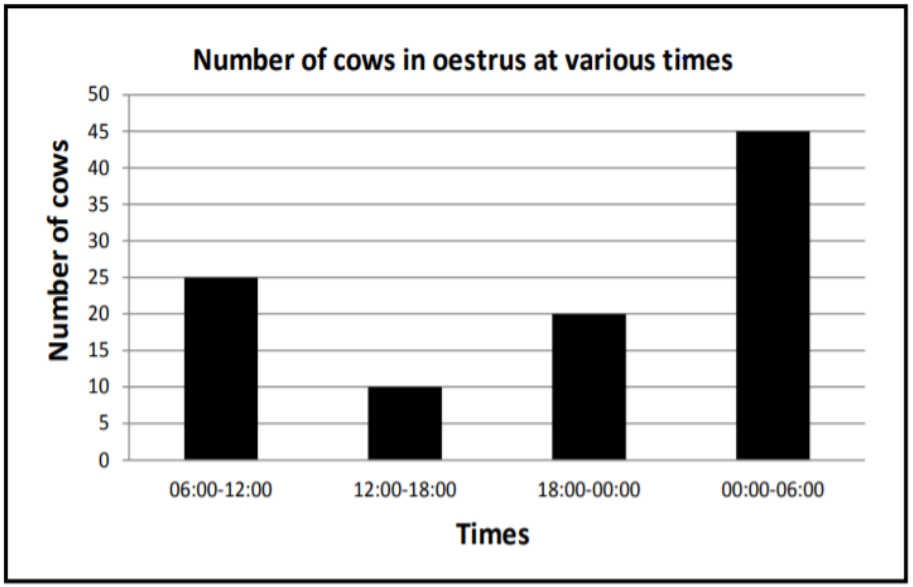
- Develop the functions of the secondary sex organs ✓
- Responsible for the onset of oestrus/behaviour changes ✓
- Signs of oestrus ✓
- Contraction of the uterus ✓
- Promote growth of the mammary duct system ✓
- Stimulates Graafian follicle✓
- Stimulates secretion of LH✓
- Delays/inhibits secretion of FSH✓
- Increases blood supply to the uterus✓
- Prevents bacterial infection of the uterus✓ (Any 1) (1)

4.2.3 **Hormone responsible for :**

(a) **Maintaining the Corpus luteum –** Progesterone ✓ (1)

(b) **Growth and development of the Graafian follicle –** FSH ✓ (1)

4.3 The graph below shows information on the oestrus cycle of dairy cattle.



4.3.1 Determine the number of cows in oestrus from 12:00 to 18:00. (1)

4.3.2 Indicate the time during which 20 cows will be in oestrus. (1)

4.3.3 Refer to the graph and predict the trend of the number of cows in oestrus from 12:00 to 06:00. (1)

4.3.4 Calculate the number of cows in oestrus from 18:00 to 06:00. (2)

4.3.5 Refer to the graph above and suggest the best time to inseminate the cows. (1)

4.3.6 Give ONE reason for the answer to QUESTION 4.3.5. (1)

Oestrus cycle of dairy cattle

4.3.1 **Determination of the number of cows on oestrus**
10 ✓

4.3.2 **Indication of time 20 cows will be in oestrus**
18:00 to 00:00 ✓

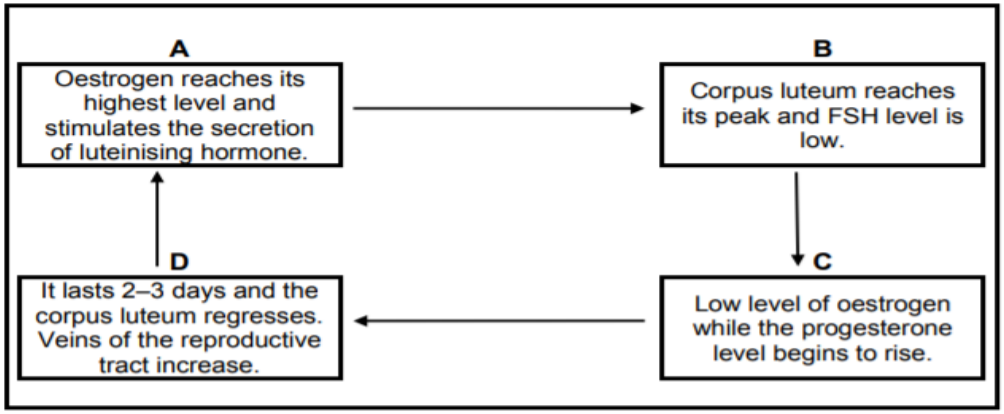
4.3.3 **Tendency of cows in oestrus from 12:00 to 06:00**
Increase/higher/more/from 10 to 45 cows ✓

4.3.4 **The number of cows in oestrus from 18:00 to 06:00**
20 + 45 cows ✓
= 65 cows✓

4.3.5 **Best time to inseminate**
12:00 to 18:00/in the afternoon✓

4.3.6 **Reason**
Time when most (45 cows) are in oestrus/in heat ✓

4.2 In female animals, hormonal and reproductive changes occur from one heat period to the next. This occurs in stages, which are marked by distinctive characteristics. Below are the characteristics applicable to each stage.



4.2.1 Match characteristics **A**, **B**, **C** and **D** with the stages of the oestrus cycle. (4)

4.2.2 Write down the letter that represents the stage where EACH of the following occurs:

(a) Graafian follicle ruptures to release the ovum (1)

(b) Ovum enters the Fallopian tube for fertilisation and the ruptured follicle forms a corpus luteum (1)

4.2 **Stages of the oestrus cycle**

4.2.1 **Labels of the phases of oestrus cycle**
A - Oestrus ✔ (1)
B - Di oestrus ✔ (1)
C - Met oestrus ✔ (1)
D - Pro oestrus ✔ (1)

4.2.2 **Indication of the letters representing the stage of oestrus**
(a) A ✔ (1)
(b) C ✔ (1)

4.2 The table below shows the levels of oestrogen and progesterone in a cow over a period of 28 days.

DAYS	PROGESTERONE (mIU/mℓ)	OESTROGENE (mIU/mℓ)
2	5	4
4	5	4
6	5	4
8	5	10
10	5	15
12	5	33
14	5	30
16	5	10
18	10	5
20	20	5
22	30	4
24	42	3
26	42	3
28	42	2

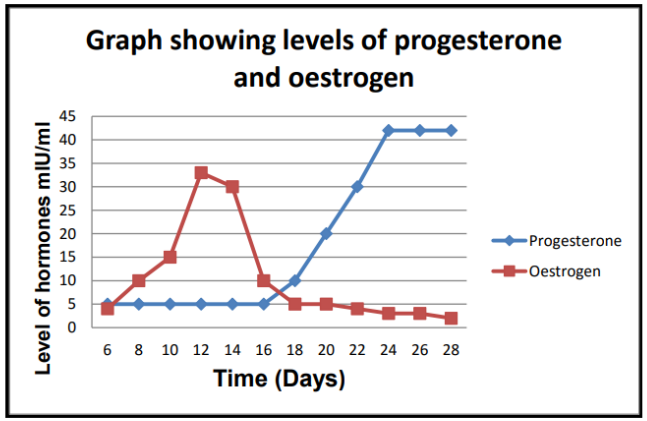
4.2.1 Present the information in the table above in the form of a line graph from day 6 to 28. (6)

4.2.2 Identify the day when the cow was on oestrus. (1)

4.2.3 Give a reason for the answer in QUESTION 4.2.2. (1)

4.2.4 Suggest with a reason the stage of oestrus in the cow on day 28. (2)

4.2.1 **Graph on levels of progesterone and oestrogen**



Criteria/rubric/marking guideline

- Correct heading √
- X-axis: Correctly labelled and calibrated (Time/days) √
- Y-axis: Correctly labelled and calibrated (Levels of progesterone and oestrogen) √
- Line graph √
- Accuracy √
- Correct units mIU/mℓ √ (6)

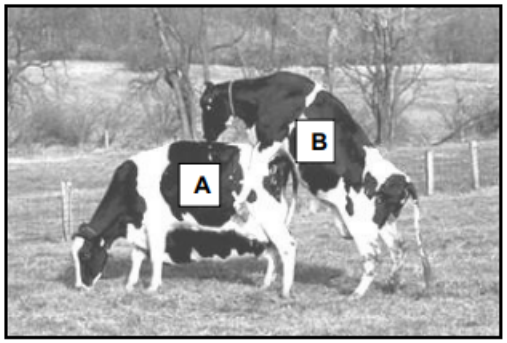
4.2.2 **Identification of the day when cow was in oestrus**
Day 12 √ (1)

4.2.3 **Reason**
Oestrogen is at its highest level √ (1)

4.2.4 **Stage of oestrus on day 28**
Di-oestrus √ (1)
Reason

- Progesterone is at its peak √
- Level of oestrogen is low √ (Any 1 x 1) (1)

4.5 The picture below shows dairy cows in oestrus.



4.5.1 Define the concept *oestrus* in dairy cows. (2)

4.5.2 State TWO visible signs of oestrus in dairy cows, except the one in the picture above. (2)

4.5.3 Name the cow (**A** or **B**) that is definitely in oestrus. (1)

4.5.4 Name the:

(a) Hormone responsible for the signs of oestrus (1)

(b) Duration of the oestrus cycle (in days) (1)

4.5 **Oestrus in dairy cows**

4.5.1 **Definition of oestrus in dairy cows**

- Period when non-pregnant cows show visible signs of oestrus ✓
- and will allow mating to take place ✓ (2)

4.5.2 **Visible signs of oestrus in dairy cattle**

- Mucus discharge from the vulva ✓
- Vulva is red/moist/swollen ✓
- Restless/bellows/excited ✓
- Feed/saliva on the back/hair is fluffed up ✓
- Feed intake decreases/loss of appetite ✓
- Milk production decreases ✓
- Sniffs the genitalia of other cows ✓
- Raises her head and curls her lips ✓
- Cows goes to the bull and allows mating✓ (Any 2) (2)

4.5.3 **Cow in oestrus**

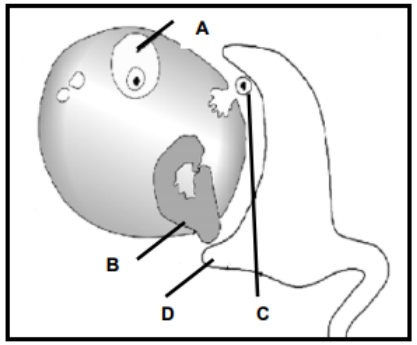
Cow A/B ✓ (1)

4.5.4 **Oestrus**

(a) Oestrogen ✓ (1)

(b) 21 days ✓ (1)

4.2 The diagram below illustrates the role of hormones in the development and functioning of organs in the female animal.



4.2.1 Name parts **A** and **C**. (2)

4.2.2 Indicate the hormone that:

(a) Stimulates the growth and development of part **A** (1)

(b) Is produced by part **B** (1)

4.2.3 State the function of part **D**. (1)

4.2.1 **Naming parts**

A Mature Graafian follicle ✓ (1)

C Ovum/egg/female reproductive cell/gamete ✓ (1)

4.2.2 **Indication of hormone**

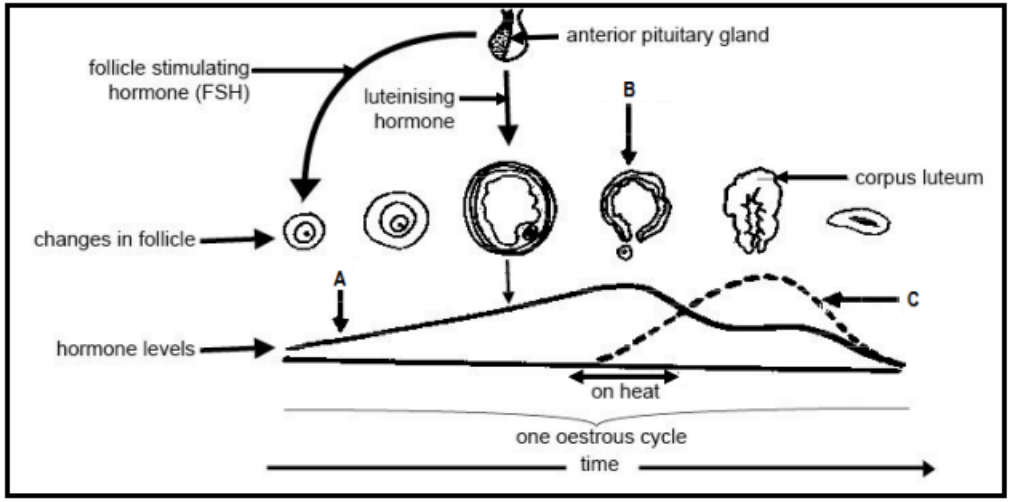
(a) Follicle stimulating hormone/FSH✓ (1)

(b) Progesterone ✓ (1)

4.2.3 **The function of infundibulum**

It captures(picks up) the ova/channel ova into the fallopian tube ✓ (1)

4.2 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.



4.2.1 Identify hormone **A** and hormone **C**. (2)

4.2.2 Explain the process at **B**. (2)

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

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

4.2 **Hormonal control during the oestrus cycle**

4.2.1 **Identification of the hormones**

A Oestrogen ✓
C Progesterone ✓ (2)

4.2.2 **Explanation of the process in B**

Release of the ovum/egg cell ✓ from a mature Graafian follicle ✓ (2)

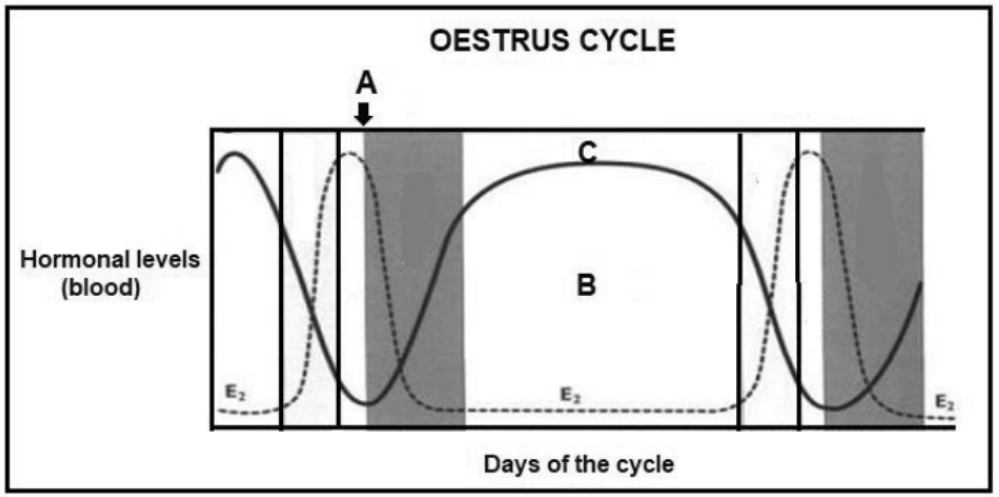
4.2.3 **TWO visible signs displayed when oestrus is in its peak**

- Mounts other cows ✓
- Restlessness ✓
- Swelling of the vulva ✓
- Excessive mucus secretion from the vulva ✓
- Mucus membranes of the vagina appears red and moist ✓
- Scratches, manure and mud on the rear end ✓
- Allows mating ✓
- Tail head is in a raised position ✓
- Tail head and hair is fluffed up ✓ (Any 2) (2)

4.2.4 **Function of FSH**

- Stimulates the formation of follicles ✓
- Facilitates/stimulates growth/development and function of the Graafian follicle ✓ (Any 1) (1)

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



4.3.1 Name the hormone labelled **C**. (1)

4.3.2 Indicate with a reason the stage of oestrus cycle indicated by the letter **B**. (2)

4.3.3 Name the process represented by **A** in the graph above. (1)

4.3.4 Name TWO visible signs of a cow on oestrus. (2)

4.3 **Oestrus cycle graph**

4.3.1 **Name of the hormone labelled C**

Progesterone ✓ (1)

4.3.2 **Indication of the stage of oestrus**

- Di-oestrus ✓

Reason

- It is the longest / it lasts longer ✓
- High levels of progesterone ✓ (Any 2) (2)

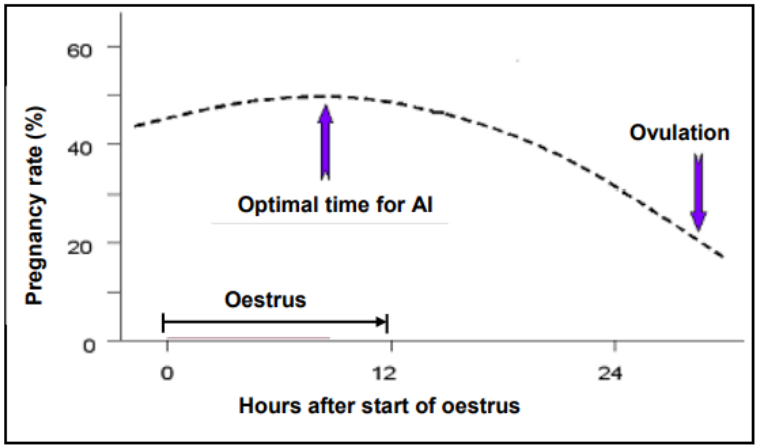
4.3.3 **Process represented by A**

- Ovulation ✓ (1)

4.3.4 **TWO visible signs of a cow on oestrus**

- Vulva is swollen with reddish mucus membranes ✓
- Mucus strings visible from the vulva ✓
- Jumps on other cows / allows other cows to jump on her ✓
- Scratch marks and dirt on the side and back ✓
- Allows mating with the bull ✓ (Any 2) (2)

4.3 The illustration below shows a process that occurs in female animals.



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

4.3.2 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)

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

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

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

4.3.1 **Identification of the hours after oestrus to get the highest pregnancy rate**
10 to 13 hours after onset of oestrus ✓ (1)

4.3.2 **A reason why the cow would allow insemination between the first hour and 12 hours after the start of oestrus**
The cow will be receptive to the bull/it will be on heat/in oestrus ✓ (1)

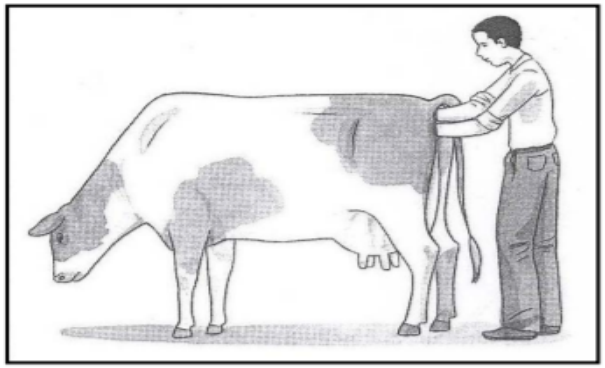
4.3.3 **TWO visible signs the cow will show when in oestrus**
- Allows mating/insemination ✓
- Mucus strings from the vulva ✓
- Swollen and red vulva ✓
- Mounts others ✓
- Hair on the back/rump are fluffed up ✓
- Mud patches on her back ✓
- Bellowing noises ✓
- Cows are excited/restless ✓
- Frequent urination ✓
- Sniffs the genitals of other cows ✓
- Raises their heads and curls her lips ✓
- Decrease in milk production ✓ (Any 2) (2)

4.3.4 **ONE reason to inseminate hours before ovulation**
- Ovum has a shorter lifespan than a sperm cell ✓
- Ovum needs to arrive when sperm cells are already waiting for fertilisation ✓ (Any 1) (1)

4.3.5 **ONE requirement for a successful insemination**
- Use of healthy/viable semen ✓
- Technique performed by a skilled/experienced technician ✓
- Insemination at the correct stage of oestrus ✓
- Use the correct sterilised equipment ✓ (Any 1) (1)

ARTIFICIAL INSEMINATION

4.1 The diagram below illustrates a special state of the reproductive cycle of the cow.



4.1.1 Name the process demonstrated in this diagram. (1)

4.1.2 Predict the part or instrument in the digestive and reproductive systems respectively touched or held by the:

(a) Right hand (1)

(b) Left hand (1)

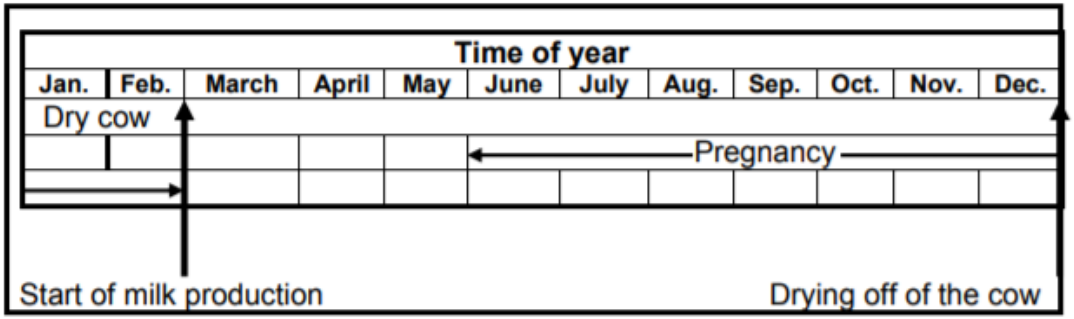
4.1.1 Pregnancy testing/Artificial insemination/Removal of retained placenta ✓ (1)

4.1.2 (a) Cervix/large intestine/developing foetus/ovary ✓ (1)
(b) Pistoulette (pipette)/vulva/vagina ✓ (1)
[3]

The data below was taken from a draft management programme for a dairy producer who synchronised the dairy production enterprise.

In the management plan for the year, the farmer tried to make provision for the following aspects:

A Artificial insemination
B Calving
C Milk production
D Conception
E Pregnancy



3.5.1 Indicate the TWO months in which artificial insemination took place in the herd of this dairy farmer. (2)

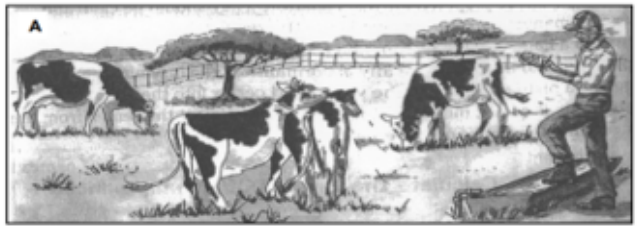
3.5.2 Deduce the process which coincided with the start of milk production in this dairy herd. (1)

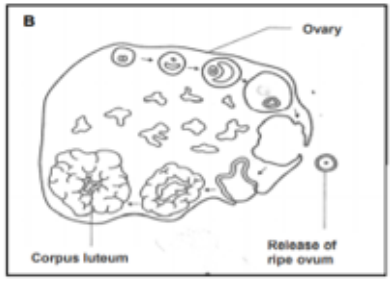
3.5.3 Name TWO ways in which this dairy producer would be affected if the cows that were inseminated at the time indicated in QUESTION 3.5.1 did not conceive. (2)

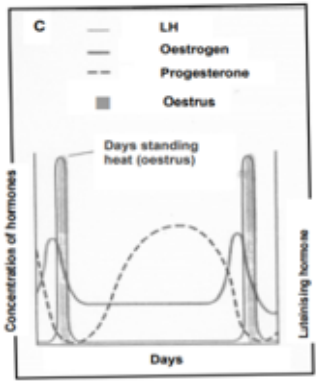
3.5.1	May ✓ June ✓	(2)
3.5.2	Calving ✓	(1)
3.5.3	Cows will be drier for longer period/less milk is produced/profit loss ✓ Dry cows need to be fed without producing an income/ maintenance costs ✓	(2) [5]

3.1 A large commercial farming enterprise has decided to make use of a well-trained inseminator to do AI (artificial insemination) in its herd of dairy cattle. He keeps a record in his own logbook. The diagrams below illustrate the following aspects:

- Diagram A: The inseminator recording the activities of the cows
- Diagram B: An ovary at the different stages of the oestrus cycle
- Diagram C: A graph that shows the changes in the hormone levels during oestrus







3.1.1 The inseminator observes that cows mount each other. Describe the possible hormonal changes that lead to the cows' behaviour by referring to Diagram C. (2)

3.1.2 Diagram C illustrates the hormone level changes of a cow at the different stages of the oestrus cycle. Explain ONE effect of the high levels of oestrogen on the cow during the heat period. (2)

3.1.3 State the best time of the day to inseminate a cow if signs of heat are detected in the morning for the first time. (1)

3.1.4 Identify the process occurring in Diagram B. (2)

3.1 **AI (ARTIFICIAL INSEMINATION)**

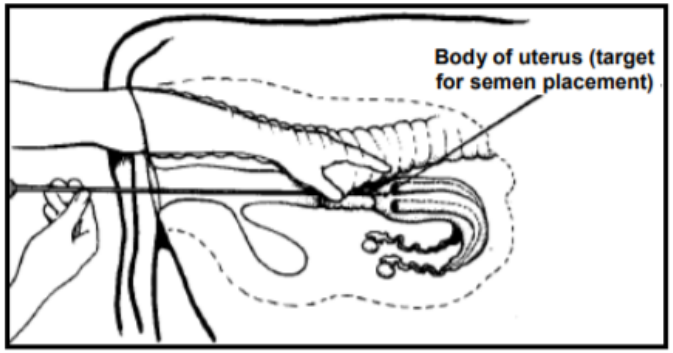
3.1.1 High levels✓
of oestrogen secreted ✓ (2)

3.1.2
- Responsible for the final preparation of uterine wall ✓✓
- Increased blood supply to the uterus ✓✓
- Relaxing of the muscles of the cervix ✓✓
- Preventing bacterial infection ✓✓
- Delay the secretion of FSH ✓✓
- Responsible for heat signs ✓✓ (any 2) (2)

3.1.3 The afternoon/after 12 hours ✓ (1)

3.1.4 Ovulation /release of ripe ovum (egg)/bursting or rupturing of graafian follicle ✓✓ (2)
[7]

4.2 The diagram below illustrates the artificial insemination (AI) technique in cattle.



4.2.1 Indicate FOUR characteristics of good, fertile semen. (4)

4.2.2 Briefly describe the treatment of the frozen semen before placing it into the pistolette for insemination. (2)

4.2.3 Suggest the best time for insemination after a cow shows the first signs of oestrus. (1)

4.2.4 Briefly explain the negative effect on a cow if the inseminator is not well trained. (2)

4.2 **Artificial insemination**

4.2.1 **Characteristics of good semen**

- opaque✓
- milky/Normal colour ✓
- sticky✓
- less than 15% dead sperm cells✓
- no deformed sperm✓
- no blood in sperm✓ (Any 4) (4)

4.2.2 **The treatment of the frozen semen**

- Frozen semen is thawed/straws placed in water✓
- At between 32°C and 35°C✓ (2)

4.2.3 **Best time of inseminating**

- 12 hours after the first signs of oestrus✓
- in the morning when signs of oestrus were detected in the afternoon and vice versa✓ (Any 1) (1)

4.2.4 **The negative effect on the cow if the inseminator is not well trained**

- The inseminated cow might sustain injuries✓
- And the reproductive life of the cow shortened✓
- Pain and stress could be experienced✓ (Any 2) (2)

4.4 Artificial Insemination (AI) makes it possible for farmers to impregnate most female animals on the farm. To get the expected results the farmer needs to observe the oestrus cycles of female animals in order to detect heat and readiness for insemination.

4.4.1 Define *artificial insemination*. (2)

4.4.2 State THREE main requirements for successful artificial insemination of farm animals. (3)

4.4 **Artificial insemination in farm animals**

4.4.1 **Definition of AI**

- A technique whereby semen is artificially collected from bulls ✓
- and artificially placed into the reproductive tract of a female ✓ (2)

4.4.2 **THREE requirements for successful AI**

- Correct detection of heat/oestrus ✓
- Correct timing ✓
- Use of viable semen ✓
- Correct technique ✓
- Experienced and knowledgeable inseminator ✓
- Observation of hygiene ✓ (Any 3) (3)

4.2 A farmer had four bulls and 100 dairy cows on a farm. Mysteriously, all the bulls were stolen. The farmer had no money to replace the bulls and therefore started looking for other options. The farmer was advised by an agricultural extension officer to consider using artificial insemination (AI).

4.2.1 Define the term *artificial insemination*. (3)

4.2.2 State TWO prerequisites for the successful administration of artificial insemination. (2)

4.2.3 List THREE dilutants commonly used to dilute semen. (3)

4.2.4 Suggest ONE method a farmer may adopt in order for the cows to produce offspring without administering AI. (1)

4.2.1 **Definition of artificial insemination**
- The collection of semen from the bull and ✓
- Placing of the semen into the reproductive canal of a cow ✓
- Leading to the fertilisation without natural mating ✓ (3)

4.2.2 **TWO prerequisites for the successful artificial insemination**
- Cows must be in oestrus/heat ✓
- AI must take place on the correct point in oestrus/timing ✓
- Use healthy/uninfected/viable semen ✓
- Used sterilized instruments ✓
- Done by qualified person/personnel/correct technique ✓

(Any 2) (2)

4.2.3 **THREE dilutants commonly used to dilute semen**
- Milk ✓
- Fructose/glucose (nutrients) ✓
- Egg yolk ✓
- Lipids ✓
- Glycerol ✓
- Buffers/sodium citrate ✓
- Antibiotics/penicillin ✓

(Any 3) (3)

4.2.4 **ONE other method for his cows to produce offspring**
- Cloning ✓
- Natural mating ✓

(Any 1) (1)

4.6 Once semen has been collected it needs to be processed as quickly as possible. During processing semen is diluted with various substances to preserve it for artificial insemination later on.

4.6.1 Name TWO substances normally used as dilutants of semen. (2)

4.6.2 State TWO functions of the dilutants mentioned in QUESTION 4.6.1. (2)

4.6 **Semen**

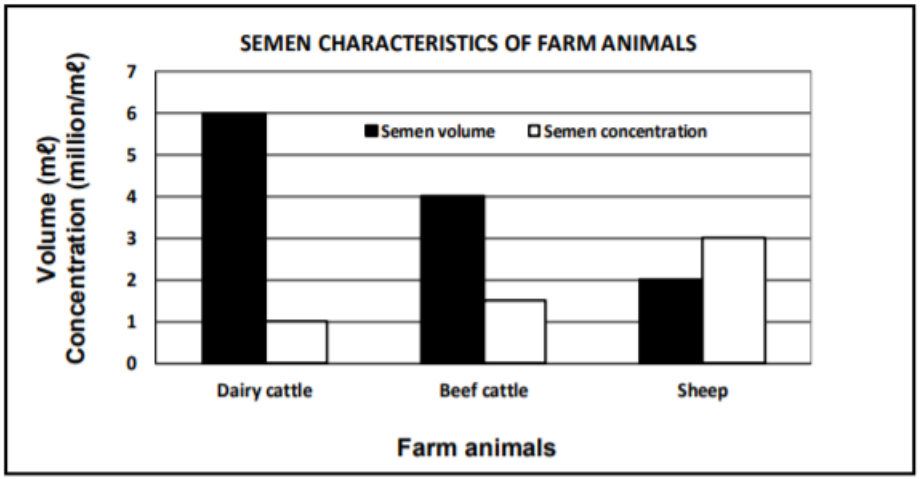
4.6.1 **TWO semen dilutants**

- Buffers/sodium citrate ✓
- Egg yolk ✓
- Lipids/Skim milk ✓
- Nutrients/Fructose ✓
- Antibiotics/Penicillin/Streptomycin ✓
- Glycerol ✓ (Any 2) (2)

4.6.2 **TWO functions of the dilutants**

- Control the pH ✓
- Control the isotonic environment ✓
- Protect spermatozoa against temperature changes/shocks ✓
- Provide energy to spermatozoa/increase viability ✓
- Protect sperm against bacterial growth ✓
- Protect spermatozoa against the lethal effects of freezing ✓
- Increase the volume of semen ✓ (Any 2) (2)

4.1 The graph below shows the volume and concentration of semen in different farm animals.



4.1.1 Determine the concentration of semen at a volume of 6 mℓ in dairy cattle. (1)

4.1.2 Refer to the graph and give the correlation between semen volume and semen concentration of dairy cattle and sheep. (4)

4.2 The colour and quality of semen will determine the success of artificially inseminating livestock.

4.2.1 Give a reason why semen could have the following colour:

(a) Red (1)

(b) Grey (1)

4.2.2 State TWO ways in which the quality of semen may be negatively affected. (2)

4.1 **Graph showing volume and concentration of semen in animals**

4.1.1 **Concentration of semen at volume of 6ml**

- 1 billion/ml ✓ (1)

4.1.2 **Correlation**

Dairy cattle

- Dairy bulls produce a lot of semen✓that is less concentrated ✓ (2)

Sheep

- Sheep produce less semen✓ that is highly concentrated ✓ (2)

4.2 **Semen colour and quality**

4.2.1 **Reason for the colour of semen**

(a) Presence of fresh blood ✓ (1)
(b) Presence of old blood/infection ✓ (1)

4.2.2 **TWO negative effects on quality of semen**

- Poor nutrition ✓
- Severe environmental conditions/temperature✓
- Age✓
- Diseases ✓ (Any 2) (2)

4.3 The success of any insemination process depends on the use of clean semen, amongst other things. Stock owners need to be proactive and take the necessary steps to prevent the transmission of diseases in bulls and rams. These diseases may have serious implications, such as the loss of the entire herd, if not controlled.

4.3.1 Name ONE method that could be used by stock owners to detect the presence of the diseases in semen. (1)

4.3.2 State TWO requirements of successful artificial insemination. (2)

4.3.3 Equipment used during artificial insemination is described below. Give the name of EACH:

(a) A rectal probe with a number of linear-banded electrodes that are connected to a variable current and voltage source (1)

(b) A storage container for semen at -196 °C for several years (1)

(c) Polyvinyl equipment that contains and stores semen (1)

4.3.4 Suggest TWO disadvantages of artificial insemination in contrast with natural mating. (2)

4.3.1 **Method of detecting the presence of the diseases in semen**

- Microscopic examination ✓
- Macroscopic/physical examination ✓ (Any 1) (1)

4.3.2 **TWO requirements for successful artificial insemination**

- Use only good quality/live/viable/healthy/clean semen ✓
- Correct technique ✓
- Operator with experience/expert knowledge/skill ✓
- Correct timing/cows needs to be in oestrus ✓
- Clean/sterile equipment ✓ (Any 2) (2)

4.3.3 **Equipment used for artificial insemination**

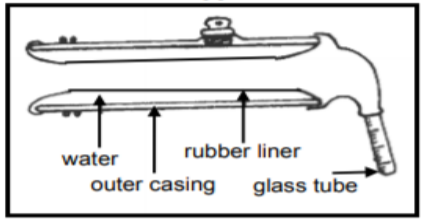
(a) Electro-ejaculator/electrical stimulation probe ✓ (1)
(b) Nitrogen flask/tank ✓ (1)
(c) Semen straw ✓ (1)

4.3.4 **TWO disadvantages of artificial insemination**

- Spread of diseases if semen is not tested ✓
- Inexperience/unskilled operator may cause damage to the animal ✓
- Decreased genetic variation ✓
- Some heifers are difficult to inseminate successfully ✓
- May not give the desirable results ✓
- Higher management demands ✓
- Undesirable traits/congenital defects may be transferred to more offspring ✓
- Labour intensive ✓
- Time consuming ✓
- Expensive procedure ✓ (Any 2) (2)

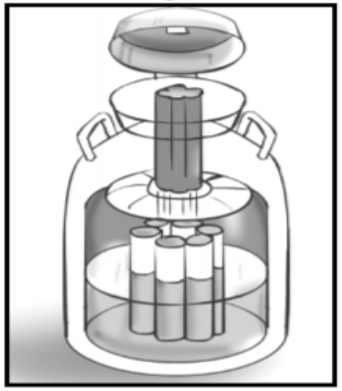
4.4 The diagrams below show different apparatus that are used in the process of artificial insemination (AI).

A



B

C



4.4.1 Identify apparatus **A**, **B** and **C** above. (3)

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

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

4.4.1 **Identification of the apparatus**

A - Artificial vagina ✓ (1)
B - Pistolette ✓ (1)
C - Nitrogen flask/canister/tank ✓ (1)

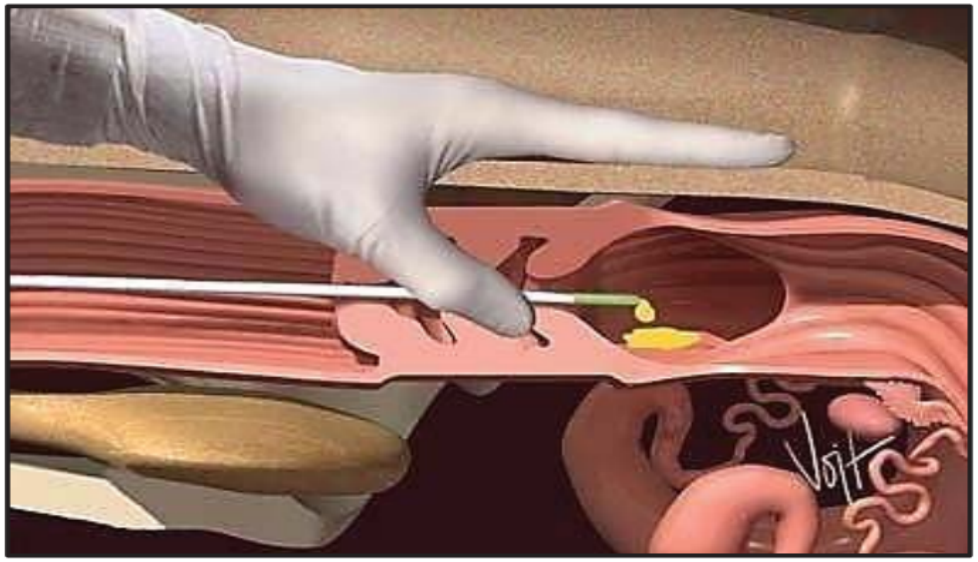
4.4.2 **Function of each apparatus**

A - Collection of semen ✓ (1)
B - For the deposition of semen in the cow during AI ✓ (1)
C - Storage of semen for longer periods ✓ (1)

4.4.3 **TWO basic requirements for the collection of semen from bulls**

- Should be close to a laboratory ✓
- Equipment must be clean/sterilised ✓
- Availability of appropriate equipment/artificial vagina ✓
- Male animal must be clean/healthy ✓

4.4 The picture below shows a reproductive process performed in a cow.



4.4.1 Identify the process performed in the animal above. (1)

4.4.2 Name TWO requirements for the success of the process in QUESTION 4.4.1 that are visible in the picture. (2)

4.4.3 Indicate TWO economic benefits of the process for the farmer. (2)

4.4.1 **Identification of the process**
Artificial insemination √ (1)

4.4.2 **TWO requirements of AI that are visible**
- Correct technique √
- Trained personnel √ (2)

4.4.3 **TWO economic benefits of artificial insemination for the farmer**
- It is a quick and economical way to improve the herd/no need to buy a bull √
- Semen of one bull can inseminate many cows √ (2)

4.3 A commercial dairy farmer has 100 fertile cows and one bull. All the animals are well fed, a disease control system is in place and the enterprise is well managed. However, the calving percentage was only 55% over the last three years.

4.3.1 In the scenario above, identify the major problem in the enterprise. (1)

4.3.2 Advise the farmer on ONE scientific technique to use in cows that will result in a much higher conception rate. (1)

4.3.3 If the farmer does not use the technique in QUESTION 4.3.2, how can the conception rate of the cows be improved? (1)

4.3.4 Explain the impact of nutrition on the fertility of bulls. (2)

4.3.5 Give TWO other reasons why the bull in the scenario above performs poorly. (2)

4.3 **Dairy farmer with 100 cows and one bull**

4.3.1 **Identification of the problem in this enterprise**
- Bull: cow ratio not proportional/1 bull to 100 cows ✓
- The calving percentage is too low/conception rate problems ✓

(Any 1) (1)

4.3.2 **Scientific technique that will result in a higher calving percentage**
Artificial insemination/AI ✓ (1)

4.3.3 **Other method to improve the calving percentage**
Make use of more bulls/3–5 bulls ✓ (1)

4.3.4 **Impact of nutrition on the fertility of bulls**
- Underfeeding impacts negatively on spermatogenesis/sperm formation/volume/quality of semen ✓
- Overfeeding causes bulls to become fat/heavy/lazy reducing the ability to service cows(libido) ✓

(2)

4.3.5 **TWO other reasons for this bull performing poorly**
- Over exertion/exhaustion ✓
- Old age ✓
- Lack of libido ✓
- Conformational abnormalities ✓
- Inability to fertilise/low sperm count ✓

(Any 2) (2)

4.4 Artificial insemination (AI) is a technique used by farmers to improve the quality of their livestock.

4.4.1 Indicate TWO characteristics of high quality semen for successful insemination. (2)

4.4.2 Give the function of EACH of the following dilutants of semen:

(a) Fructose (1)

(b) Glycerol (1)

(c) Antibiotics (1)

4.4.3 Name TWO disadvantages of AI. (2)

4.4.4 Name TWO congenital defects in bulls that can lead to unsuccessful fertilisation. (2)

4.4 **Artificial Insemination (AI)**

4.4.1 **TWO characteristics of good quality semen**

- Viability/mobility/motility/80% mobility/less than 15% dead sperm cells ✓
- Colour/opaque/milky white ✓
- Volume ✓
- Odour ✓
- pH between 6,4 - 6,9/slightly acidic pH ✓
- Percentage of sperm cells with defects/morphology/less than 20% deformation/fewer deformities ✓
- Concentration ✓
- No blood in semen ✓ (Any 2) (2)

4.4.2 **Functions of the dilutants of semen**

(a) Provides energy for sperm cells ✓ (1)

(b) Protects sperm cells against temperature changes/damage from freezing ✓ (1)

(c) Protects sperm cells against bacterial growth/infections ✓ (1)

4.4.3 **TWO disadvantages of AI**

- Labour intensive procedure ✓
- Time consuming ✓
- Incompetent operator can harm/damage cows ✓
- Diseases can spread quickly/easily ✓
- Genetic abnormalities can spread quickly/easily ✓
- Heat detection is difficult under extensive farming conditions ✓
- Expensive in terms of storage/testing ✓
- Not always successful/improper handling can decrease conception rate ✓
- Inbreeding may occur ✓
- Genetic variability is reduced ✓
- High levels of management is needed ✓
- Expert knowledge is required ✓ (Any 2) (2)

4.4.4 **TWO congenital defects in bulls**

- Cryptorchidism ✓
- Hermaphroditism ✓
- Hypoplasia ✓
- Sperm defects ✓ (Any 2) (2)

4.3 Artificial insemination is one of the important processes performed in female animals to increase the herd economically and rapidly.

Below are the steps that are involved before and during artificial insemination to ensure successful conception:

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

4.3.1 Re-arrange the steps above in chronological order to ensure successful artificial insemination. (5)

4.3.2 State TWO economic benefits of artificial insemination for a farmer. (2)

4.3 **Artificial Insemination**

4.3.1 **Arrangement of the steps during AI chronologically**

- Semen harvesting ✓
- Semen examination ✓
- Semen dilution ✓
- Heat detention ✓
- Placing of semen into the reproductive tract of a cow ✓ (5)

4.3.2 **TWO economic benefits of AI for the farmer**

- More female animals can be fertilised by superior male animals ✓
- It is a quick and economic way of improving the herd ✓
- Commercial value of herd is improved ✓
- No need to buy an expensive bull ✓
- Higher conception rate ✓ (Any 2 x 1) (2)

4.3 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.

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

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

4.3 **Correct technique for AI**

4.3.1 **Re-arranging the steps during AI**

- A cow is sheltered and kept calm ✓
- Excess faecal matter is removed ✓
- Inseminator checks abnormalities and whether the cow is not pregnant by inserting the hand through the rectum ✓
- The pistolette is guided through the vulva, vagina to the cervix ✓ (4)

4.3.2 **TWO disadvantages of AI for the farmer**

- Disease transmission can affect large number of cows ✓
- Infections can occur/venereal diseases can spread quickly ✓
- Genetic abnormalities can occur ✓
- Inexperienced operator can damage the reproductive organs ✓
- Low success rate when using inexperienced technician ✓
- Labour intensive ✓
- Expensive ✓
- More time consuming ✓
- Not always successful ✓
- Does not necessarily improve the genetics of the herd ✓
- Genetic variability can decrease ✓
- If records are not kept carefully, inbreeding can occur ✓
- Undesirable traits can be transferred to more offspring ✓ (Any 2) (2)

4.3 Semen from the bull can be harvested, examined, diluted and stored for later use.

4.3.1 Name TWO requirements for semen collection. (2)

4.3.2 Indicate the main purpose of diluting the semen. (1)

4.3.3 The storage of semen has an advantage for the farmer. Justify this statement by giving TWO advantages. (2)

4.3 **Semen collection, dilution and storage**

4.3.1 **TWO requirements for semen collection**

- Equipment must be sterile and readily available √
- Bull must be clean during semen collection √
- Collecting vial must be warmed to prevent damage to sperm cells caused by cold shock √
- Area where semen is collected must be close to a laboratory √
- Presence of a teaser bull √ (Any 2 x 1) (2)

4.3.2 **Indication of the main purpose for diluting the semen**

- To increase the volume of the semen √ (1)

4.3.3 **TWO advantages of storing semen for the farmer**

- Extending the productive life of superior bulls √
- No need to keep and maintain expensive bulls √ (2)

CLONING AND EMBRYO TRANSFER

4.5 The statements below indicate the main stages of a reproductive technique conducted in cows:

A. Flushing the embryo from the donor cow
B. Artificial insemination of the donor cow
C. Super ovulation of the donor cow
D. Placement of the embryo in the recipient cow
E. Synchronisation of both donor and recipient cows

4.5.1 Identify the reproductive technique above. (1)

4.5.2 Re-arrange the above statements (A–E) in the correct order. (5)

4.5.3 State TWO benefits of this reproductive technique. (2)

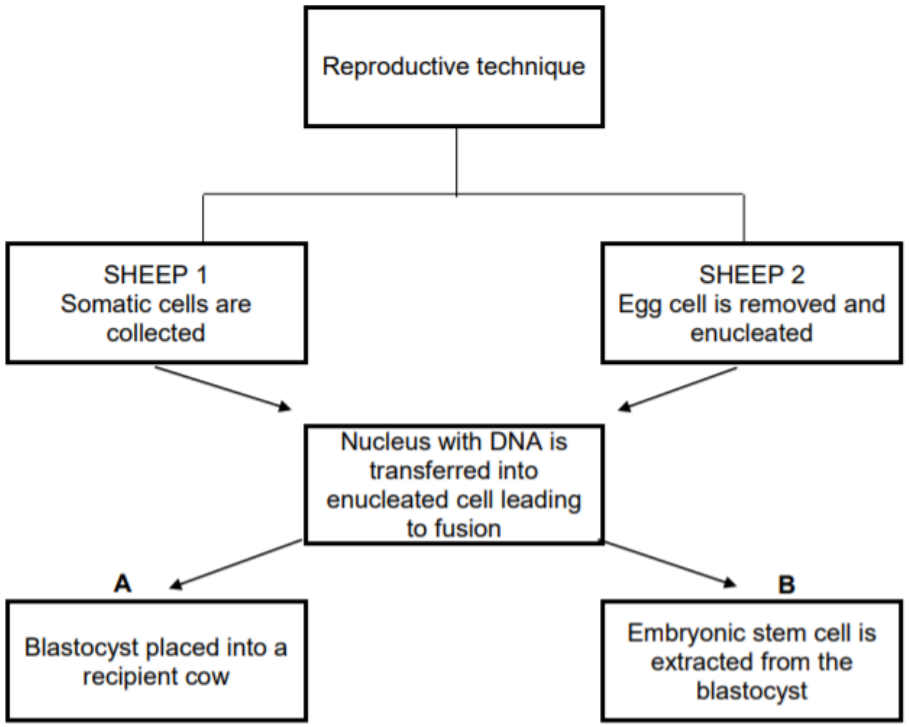
4.5 **Stages of embryo transfer**

4.5.1 **Identification of technique**
Embryo transfer/ET ✓ (1)

4.5.2 **Correct order of embryo transfer**
- E/Synchronisation of both donor and recipient cows ✓
- C/Super ovulation of the donor cow ✓
- B/Artificial insemination of the donor cow ✓
- A/Flushing the embryo from the donor cow ✓
- D/Placement of the embryo in the recipient cow ✓ (5)

4.5.3 **TWO benefits of ET**
- More progeny are produced from the best cows ✓
- Profits are made from sales of quality genetics ✓
- Fast cost effective method to improve genetic make-up of the herd ✓
- Extended reproductive life of older and incapable cows ✓
- Genetics in the herd conserved ✓
- Animals can be bred for improved diseases resistance/ milk/meat production (Any 2) (2)

4.6 The illustration below show processes occurring during a reproductive technique in female animals.



4.6.1 Identify the reproductive technique illustrated above. (1)

4.6.2 Indicate an appropriate name given to an animal represented by sheep 1 and sheep 2. (2)

4.6.3 There are TWO main types of the technique mentioned in QUESTION 4.6.1. Indicate these main types as labelled in **A** and **B**. (2)

4.6.4 Indicate the purpose for which the technique labelled **B** is done. (1)

4.6.5 The technique in **A** has an economic benefit for the farmer. Validate this statement by mentioning TWO economic benefits of this technique to the farmer. (2)

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4.6 4.6.1 Cloning √ (1)

4.6.2 **Sheep 1** Donor √
Sheep 2 Recipient √ (2)

4.6.3 **A** Reproductive cloning √
B Therapeutic cloning √ (2)

4.6.4 For the production of medicines to treat different diseases √ (1)

4.6.5
- High quality products (meat, wool, et cetera) √
- Farmers farm with best animals with desirable characteristics √
- Animals can be bred for disease resistance thus, decreasing the cost of treatment √
- Extinct and endangered species can be revived √
- One female can produce many clones √ (Any 2) (2)

4.4 Currently modern technologies like artificial insemination (AI), synchronisation of oestrus and embryo transfer (ET) are used by farmers to enhance faster and better production, productivity and genetic superiority in farm animals.

4.4.1 Describe the *synchronisation of oestrus.* (2)

4.4.2 State THREE advantages of AI for dairy cows. (3)

4.4.3 Indicate FOUR processes followed during embryo transfer in the correct sequence. (4)

4.4 **Modern technologies: artificial insemination (AI), synchronization, etc.**

4.4.1 **Description of synchronisation of oestrus**

- Making the oestrus cycle of a number of female animals✓
- to occur approximately at the same time✓ (2)

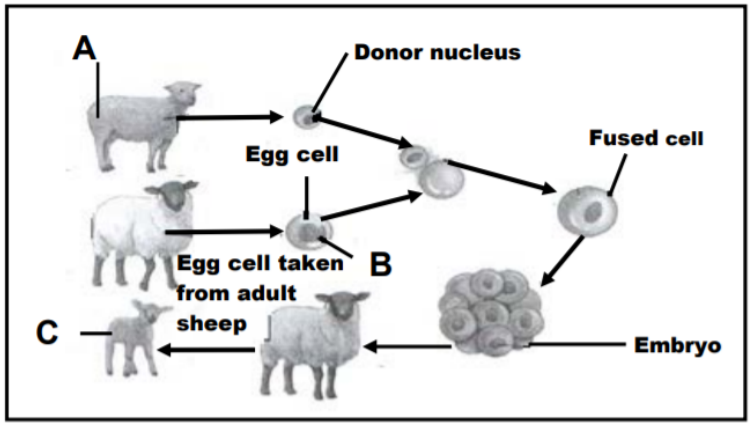
4.4.2 **THREE advantages of AI in dairy cows**

- Improving the genetic quality of the offspring✓
- No need to buy/manage expensive bulls✓
- Can use semen of one bull to inseminate many cows✓
- Prevents the spread of sexually transmitted diseases✓
- Inferior sires can be detected✓
- Can use semen from a bull after injury or death✓
- Animals of different size can be mated without injury✓
- Semen can be frozen for many years✓
- Semen can be transported and used worldwide✓
- An ejaculation of one bull can be used for many cows✓
- Higher conception rate can be achieved✓ (Any 3) (3)

4.4.3 **FOUR sequential stages used in ET**

- Synchronisation of oestrus in donor and recipient cows✓
- Superovulation of donor cows✓
- Insemination of donor cows✓
- Washing of the embryo from the uterus✓
- Transfer embryo into the uterus of recipient cows✓ (Any 4) (4)

4.4 The diagram below represents a reproductive process in sheep.



4.4.1 Identify the type of reproductive process in the diagram above. (1)

4.4.2 Define the process in QUESTION 4.4.1. (2)

4.4.3 Describe the stage represented by **B**. (1)

4.4.4 Suggest THREE aims of the process in QUESTION 4.4.1. (3)

4.4.1 **Reproductive process**

- Cloning/nuclear transfer ✓ (1)

4.4.2 **Definition of cloning**

- A process through which an identical copy of the donor animal is produced ✓
- from its nucleus ✓ (2)

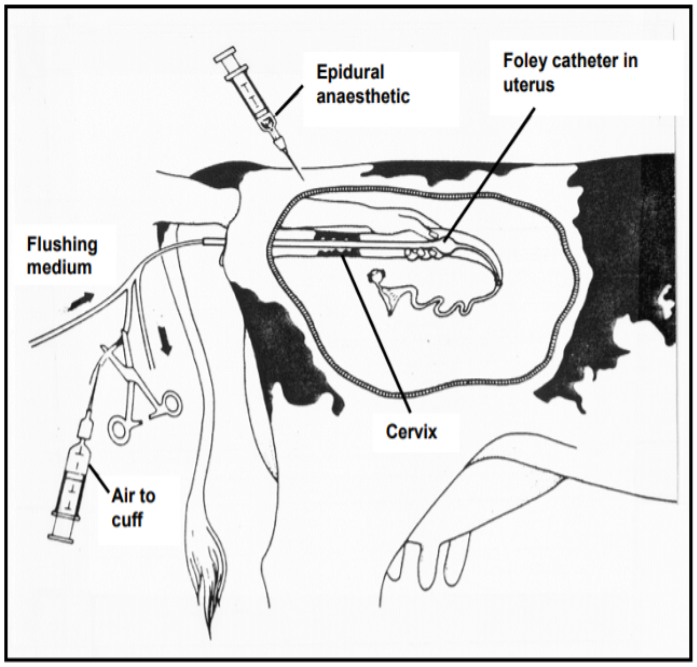
4.4.3 **Description of stage B**

- Removal of the nucleus ✓ (1)

4.4.4 **Aims of cloning**

- Produce large numbers of genetically identical animals ✓
- Production of offspring from a higher quality animal ✓
- Preservation of superior genetics/characteristics ✓
- Increase the population size of endangered species ✓
- Achieve high quality meat and dairy products ✓
- For medical purposes ✓ (Any 3) (3)

4.5 The diagram below represents embryo transplant (ET).



4.5.1 Identify the type of cow where the procedure above will be followed. (1)

4.5.2 Motivate the answer to QUESTION 4.5.1. (1)

4.5.3 Define the concept *recipient cow*. (2)

4.5.4 State TWO disadvantages of embryo transplants. (2)

4.5.5 Give the main reason for embryo transplants. (1)

4.5 **Embryo transplant (ET)**

4.5.1 **Type of cow**
Donor/superior cow ✓ (1)

4.5.2 **Motivation**
Embryos are flushed from the uterus ✓ (1)

4.5.3 **The concept recipient cow**
An inferior/surrogate cow that receives an embryo, mothers and gives birth ✓ to a superior calf ✓ (2)

4.5.4 **TWO disadvantages of embryo transplant**
- Conception rate is low ✓
- Expensive procedure/no guarantees for success ✓
- Very scientific/complex procedure ✓
- Expert knowledge/skills required/veterinarian ✓
- Time consuming/labour intensive ✓
- Diseases can be transmitted ✓
- Abortions may occur ✓ (Any 2) (2)

4.5.5 **The main reason for embryo transplant**
To produce more genetically superior offspring from genetically superior parents ✓ (1)

4.5 The initial stages of embryo transfer (ET) involve the treatment of genetically superior cows to superovulate. These cows are then artificially inseminated with semen from proven bulls.

4.5.1 Define the term *superovulate*. (2)

4.5.2 Name THREE advantages of the process of embryo transfer (ET). (3)

4.5.3 Give a reason for using proven bulls. (1)

4.5 The table below represents different procedures, **1**, **2** and **3**, that are used in animal reproduction.

PROCEDURE 1	PROCEDURE 2	PROCEDURE 3
Semen of selected farm animals is collected, processed and used for animal reproduction	Many embryos are harvested from selected farm animals then used for reproduction	Nucleus of a cell from one animal is removed and placed into a prepared egg cell to be used for reproduction

Identify the procedure in animal reproduction (**1**, **2** or **3**) that is associated with the following:

(a) Embryo transplantation (1)
(b) Cloning (1)
(c) Artificial insemination (1)

4.5 **Table of different processes**

(a) 2 ✓
(b) 3 ✓
(c) 1 ✓ (3)

4.3 Breeders are using new methods to increase the number of offspring and to improve the genetics of the progeny. Choosing the appropriate time to calve is also vital.

The following are different techniques used to achieve the goals above:

- Artificial insemination
- Embryo transplantation
- Cloning

4.3.1 Choose a technique in the scenario above that matches EACH of the procedures that follow:

(a) The nucleus containing DNA is removed from the egg cell and the egg cell is enucleated. (1)

(b) A viable embryo is recovered from the donor using a Foley catheter. (1)

(c) Viable semen is harvested through electro-ejaculation. (1)

(d) Use somatic cells to produce a genetically identical organism. (1)

4.3.2 State the correct stage of the oestrus cycle to inseminate cows successfully. (1)

4.3.3 Why is the relationship between ovulation and the timing of insemination important? (3)

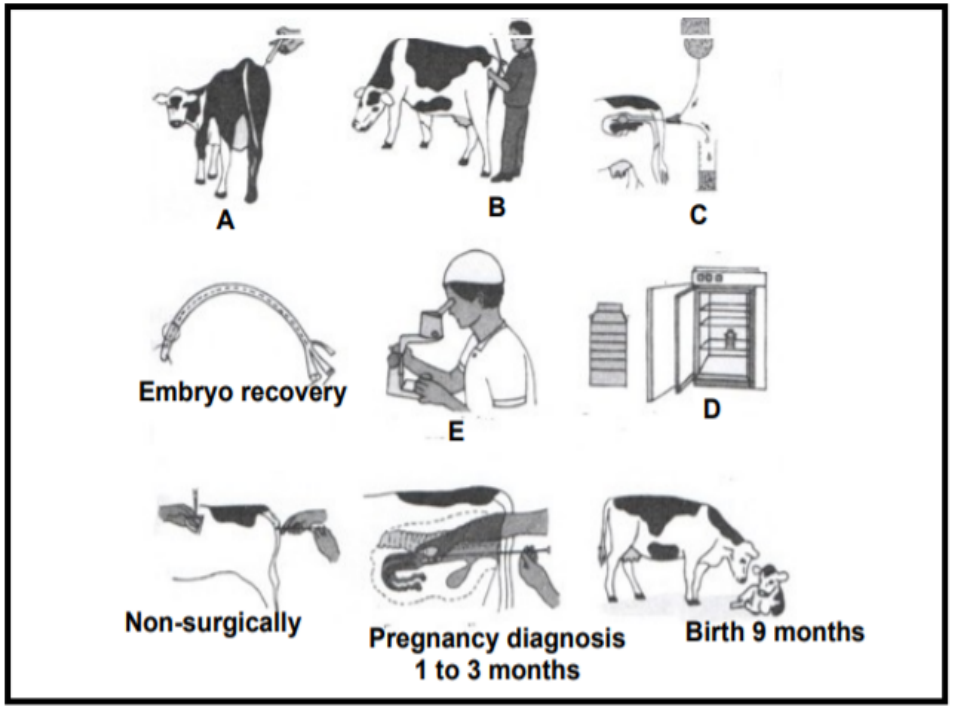
4.3 **Techniques to increase number of offspring**

4.3.1 (a) Cloning ✓ (1)
(b) Embryo Transplantation ✓ (1)
(c) Artificial insemination ✓ (1)
(d) Cloning ✓ (1)

4.3.2 **Correct stage of insemination**
Oestrus ✓ (1)

4.3.3 **Relationship between ovulation and insemination timing**
- AI should be performed approximately 6–14 hours before ovulation ✓
- That gives time for semen to move to the fallopian tube ✓
- So that the ovum does not wait too long before fertilisation ✓ (3)

4.1 The illustration below indicate the steps involved during a reproductive process.



4.1.1 Identify the reproductive process illustrated above. (1)

4.1.2 Name TWO hormones that initiate the step labelled **A**. (2)

4.1.3 Provide the name given to animal labelled **A**. (1)

4.1.4 Indicate the temperature requirement in label **D** if the procedure is delayed up to 8 hours. (1)

4.1.5 Explain how the farmer can benefit from the process through the following:

(a) Non-producing and older cows (1)

(b) Economic benefit (1)

4.1.1 Embryo transfer √

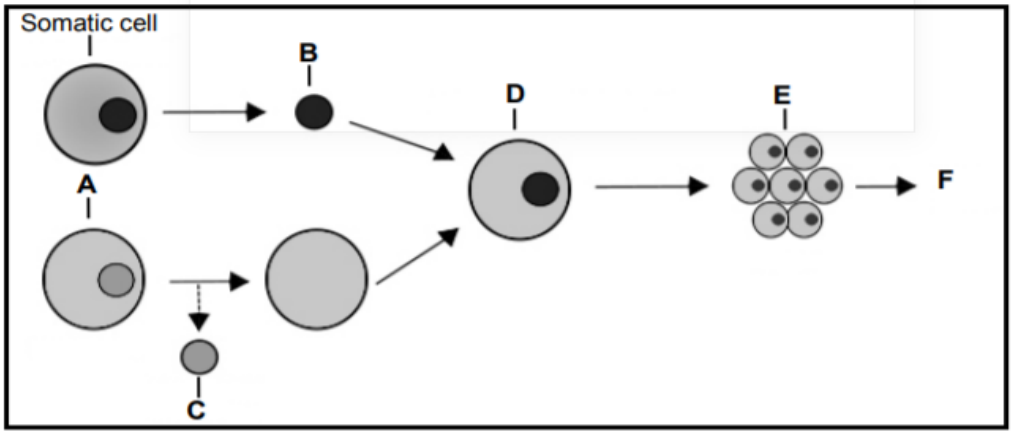
4.1.2
- Prostglandin injection √
- Gonadotropin - release hormone √

4.1.3 **A** Donor √

4.1.4 37 °C √

4.1.5 (a) Their reproductive cycle is extended to
(b) More profit from selling superior animal

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



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

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

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

4.3.1 **The process illustrated in the diagram**
Nuclear transfer/cloning ✓ (1)

4.3.2 **Identification of the cells**
A - Recipient cell with nucleus/egg cell/ovum ✓ (1)
B - The nucleus of the donor cell ✓ (1)
D - The fused cell ✓ (1)

4.3.3 **TWO different types of the process**
- Reproductive cloning ✓
- Therapeutic cloning ✓ (2)

4.3 A female animal is treated with hormones to make her super-ovulate. The eggs are fertilised and the embryos are removed and placed into another female animal.

4.3.1 Identify the reproductive process above. (1)

4.3.2 State TWO advantages of the reproductive process identified in QUESTION 4.3.1 to farmers. (2)

4.3.3 Give the term for a cow that has undergone the following procedures:

(a) Treated with hormones to super-ovulate (1)

(b) Placement of an embryo (1)

4.3 **Embryo transplantation**

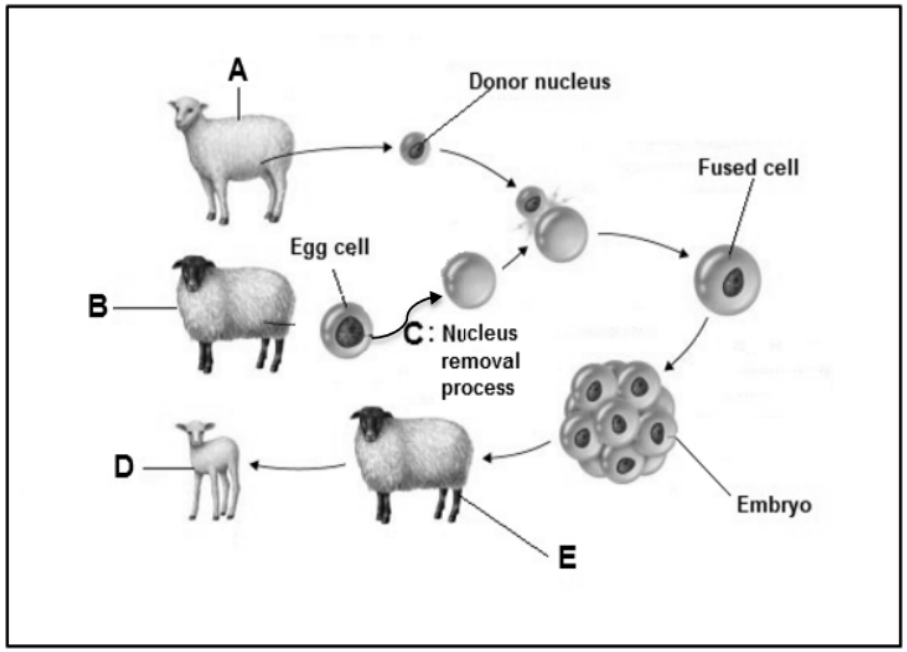
4.3.1 **Identification of the process**
Embryo transplantation/transfer/ET ✓ (1)

4.3.2 **TWO advantages of ET to farmers**
- Fast/cost effective way to increase genetic improvement ✓
- Extend the reproductive life of older/unproductive cows ✓
- Offspring from superior animals are multiplied/higher calving percentage ✓
- Genetic material in the herd is conserved ✓
- Genetic material can be transported internationally ✓
- Can improve the medical properties of products ✓
- Produce animals with improved resistance towards diseases ✓
- Prevent the extinction of valuable and endangered animals ✓
- Profits from increased sales of quality genes/products ✓
- A planned breeding programme can be implemented ✓ (Any 2) (2)

4.3.3 **The term referring to the cow that is**
(a) Donor cow ✓ (1)

(b) Recipient/surrogate cow ✓ (1)

4.4 The diagram below illustrates the reproductive process that occurs in farm animals.



4.4.1 Identify the process illustrated above. (1)

4.4.2 Indicate the letter representing the sheep that will be genetically identical to the sheep labelled **D**. (1)

4.4.3 Write the letter of the sheep that will serve as a surrogate. (1)

4.4.4 Give the name of the process labelled **C**. (1)

4.4.5 Name TWO aims of the process illustrated above. (2)

4.4 **Cloning**

4.4.1 **Identification of the process**
Cloning/Nuclear transfer ✓ (1)

4.4.2 **Letter of the sheep that is identical to the cloned sheep**
Sheep A ✓ (1)

4.4.3 **Letter of a sheep that will be a surrogate**
Sheep **E** ✓ (1)

4.4.4 **Name of the processes in C**
Enucleation ✓ (1)

4.4.5 **TWO aims of cloning**
- To produce large number of genetically identical animals ✓
- To produce offspring from high quality animals ✓
- To preserve superior genetics ✓
- To increase the number of endangered species ✓ (Any 2 x 1) (2)

4.6	State the importance of EACH of the aspects below in embryo transfer:		
	4.6.1	Superovulation	(1)
	4.6.2	Embryo flushing	(1)
	4.6.3	Donor cow	(1)
	4.6.4	Recipient cow	(1)

4.6	**The importance of the aspects of embryo transfer**		
	4.6.1	**Superovulation** For the production of more genetically superior ova ✓	(1)
	4.6.2	**Embryo flushing** For the harvest of more embryos from superior/donor cows ✓	(1)
	4.6.3	**Donor cow** For the production of superior embryo's ✓	(1)
	4.6.4	**Recipient cow** For implantation of the harvested embryo's ✓	(1)

4.7 Superior donor cows are treated with an intravaginal drug to stop the cows from coming to oestrus. FSH is injected every morning and night. Later prostaglandin is injected. After the repeated injections with formulated hormones, the superior cows are inseminated. After seven days the fertilised egg cells are removed to be implanted into the recipient cows.

4.7.1 Name the process explained in the scenario above. (1)

4.7.2 What is the importance of the process named in QUESTION 4.7.1? (2)

4.7.3 Explain what a *donor cow* is. (2)

4.7 **Embryo transfer**

4.7.1 **Process in the scenario**
Embryo transfer/ER ✓ (1)

4.7.2 Main importance of embryo transfer
Creation of multiple offspring ✓ with the desirable characteristics of superior parents ✓ (2)

4.7.3 **Explanation of a donor cow**
Production of superior ova ✓ for implantation to inferior cows ✓ (2)

4.7 In nuclear transfer (cloning), the nucleus of a somatic cell from a superior animal is transferred to an enucleated egg cell.

4.7.1 State the importance of nuclear transfer for the following:

(a) Farmer (1)

(b) Veterinarian services (1)

4.7.2 Name TWO disadvantages of nuclear transfer. (2)

4.7 **Nuclear transfer**

4.7.1 **Importance of nuclear transfer**

(a) Farmer

- Animals with desirable traits can be produced to meet the specific production needs ✓
- Preserve superior genes/animals ✓
- Farmers can produce high-quality safe and healthy food ✓
- Animals can be bred that is more resistant to diseases ✓
- Frozen cloned embryos can be transported worldwide ✓
- Many clones can be obtained from one female ✓(Any 1) (1)

(b) Veterinarian services

- Production of stem cells to find cures for diseases ✓
- Research ✓
- Valuable medicines can be produced in the milk of cows/sheep/goats ✓
- Animals with a slightly modified genetic make-up can be produced for transplantation into humans ✓
- Preserve rare/endangered species ✓ (Any 1) (1)

4.7.2 **TWO disadvantages of a nuclear transfer**

- Cloned animals have a shorter lifespan ✓
- Genetic abnormalities of a cloned animal can be transmitted to the offspring ✓
- It is expensive ✓
- Cloned animals have a low immune system ✓
- Offspring are large causing problems during parturition ✓
- Genetic diversity deteriorates/reduces variation ✓
- Premature aging of cloned animals resulting in early death ✓
- Offspring of cloned animals encounter problems with vital organs such as lungs, heart and kidneys ✓
- Requires specific skills ✓ (Any 2) (2)

4.4 Cows with the proven heritable traits are used to produce embryos which are placed on less productive cows. Below are the steps involved during this process:

- A Foley catheter is used to recover the embryo
- Semen is placed into the reproductive tract of a cow
- Isolation and classification of the embryo
- Transfer of the embryo to the uterus of a cow
- Treatment of the cow with the gonadotropin hormone

4.4.1 Re-arrange the above steps to ensure that the process is carried out with success. (5)

4.4.2 Name TWO types of cows involved in the process. (2)

4.4.3 State TWO disadvantages of the process. (2)

4.4 **Embryo Transplant/transfer**

4.4.1 **Re-arranging the steps to ensure successful embryo transfer**

- Treatment of the cow with the gonadotropin hormone ✓
- Semen is placed into the reproductive tract of a cow ✓
- Foley catheter is used to recover the embryo ✓
- Isolation and classification of the embryo ✓
- Transfer of embryo to the uterus of a cow √ (5)

4.4.2 **TWO types of cows involved in embryo transplant**

- Donor √
- Surrogate/recipient √ (2)

4.4.3 **TWO disadvantages of the embryo transplant**

- It is expensive √
- Requires skill and experience √
- Synchronisation of the recipient and donor is difficult √
- Donor may not become pregnant √
- Recipient cow could abort √
- Labour intensive √
- Time consuming √
- Decreases genetic variability √
- Greater management demand √ (Any 2 x 1) (2)

PARTURITION AND DYSTOCIA

4.4	Farm animals often have difficulty giving birth.		
4.4.1	Write down the appropriate scientific term to describe difficulties in giving birth.		(1)
4.4.2	Name THREE conditions that may interfere with normal parturition.		(3)
4.4.3	Name the indigenous lubricant used by breeders to assist cows with the delivery of calves.		(1)

4.4 **Difficulties giving birth**

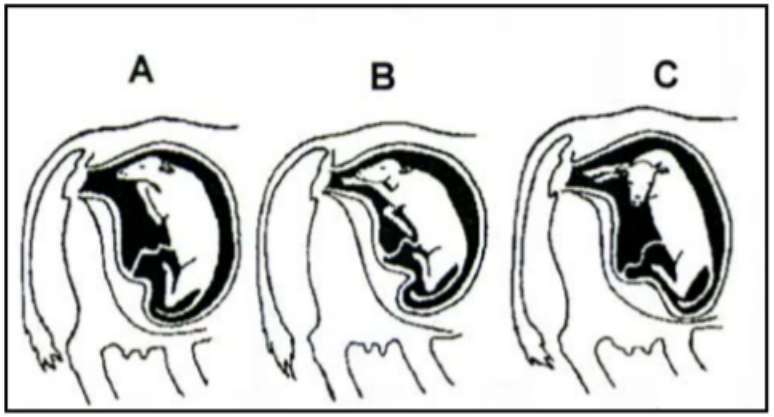
4.4.1 **Scientific term**
Dystocia ✓ (1)

4.4.2 **THREE conditions that may interfere with normal parturition**

- Deviation of the head ✓
- Flexion of the elbow ✓
- Retention of the fore leg/legs ✓
- Hydrocephalus ✓
- Congenital defects/deformities ✓
- Vaginal tear ✓
- Twins/multiple births ✓
- Premature/late birth ✓
- Induction of parturition ✓
- Posterior/abnormal presentation ✓
- Incomplete cervical dilation ✓
- Size of the calf ✓
- Malnutrition of the cow ✓
- Age of the female animal ✓ (Any 3) (3)

4.4.3 **Indigenous lubricant used by breeders in assisting delivery**
Animal fat/oil/soap ✓ (1)

4.5 Calves that are incorrectly positioned before and during the time of parturition will cause difficult calving.



4.5.1 Refer to the pictures of foetal positions (**A**–**C**) above and identify the parturition stage. (1)

4.5.2 Give the correct scientific name for the calving difficulty that might be caused by foetal positions **A**, **B** and **C**. (1)

4.5.3 Suggest TWO actions that a farmer can take to save both the calf and the cow during calving difficulty. (2)

4.5 **Foetal position**

4.5.1 **Identification of parturition stage**
Preparatory ✓ (1)

4.5.2 **Appropriate scientific name for calving difficulty**
Dystocia ✓ (1)

4.5.3 **TWO actions to save a calf and the cow**
- Correcting the position before calving ✓
- Veterinary section if position cannot be corrected ✓ (2)

4.5 Difficult births require more labour and attention. It may result in placenta retention and the death of both the cow and the calf. It is a heritable characteristic, occurring more frequently in heifers and bull calves. It can be corrected by means of proper management.

4.5.1 Give an appropriate term commonly used for *difficult births*. (1)

4.5.2 Explain the reason for difficult births in heifers. (2)

4.5.3 Indicate TWO managerial measures to reduce the probability of difficult births. (2)

4.5.4 Define the term *placenta retention*. (2)

4.5 **Difficult births**

4.5.1 **Scientific term for difficult births** (1)
Dystocia ✓

4.5.2 **Reason for difficult births in heifers**
- Heifers are physically smaller✓and less developed (younger)/age ✓
- Incorrect presentation/position/posture✓
- Too large foetus/hydrocephalus✓
- Deformities of the foetus✓
- Torsion/twisting of the foetus✓
- Prolapsed uterus✓
- Multiple births/twins✓
- Size of pelvic area✓
- Weak/ ineffective labour✓
- Cervix failing to dilate✓
- Prolonged gestation/pregnancy period✓
- Malnutrition✓
- Diseases✓ (Any 2) (2)

4.5.3 **TWO managerial measures to reduce difficult births**
- Use bulls renowned for small calves/low birth weight ✓
- Mate heifers at the ideal age/mass/not too early ✓
- Use a controlled/well-planned breeding season ✓
- Well planned feeding programme/avoid overfeeding✓
- Planned health programme ✓ (Any 2) (2)

4.5.4 **Definition of placenta retention**
- The failure to expel the placenta/membranes ✓
- within 12 hours after parturition/birth ✓
- with negative effects/complications ✓ (Any 2) (2)

4.5	Difficult birth is a challenge for farmers but can be corrected in some cases by proper management:		
	4.5.1	Give the term referring to the condition above.	(1)
	4.5.2	Indicate TWO reasons leading to the condition in QUESTION 4.5.1.	(2)

4.5	4.5.1	Dystocia √	(1)
	4.5.2	• Deviation of the head √ • Flection of the elbow √ • Retention of one or both forelegs √ • Hydrocephalus √ • Congenital defects √ • Posterior presentation/position and posture √ • Torsion of the uterus √ (Any 2)	(2)

4.6	Problems are usually experienced by heifers that are calving for the first time.		
	4.6.1	Name the condition referred to in the statement above.	(1)
	4.6.2	Give TWO signs of an animal that is experiencing birth problems.	(2)
	4.6.3	State ONE cause of birth problems in heifers.	(1)
	4.6.4	Name the hormone that initiates milk release.	(1)
	4.6.5	Name the milk produced in the first three days after calving.	(1)

4.6 Parturition

4.6.1 The condition experienced by heifers calving for the first time

Dystocia ✔ (1)

4.6.2 TWO signs of an animal experiencing birth problems

- Show signs of prolonged distress/excessive pain and discomfort ✔
- Foetus/after birth showing in birth canal without expulsion ✔
- Prolonged birth process ✔
- Exhaustion ✔

(Any 2) (2)

4.6.3 ONE cause of problems during birth in heifers

- Large foetus/small sized heifer ✔
- Small pelvic area ✔
- Inexperience ✔
- Incorrect presentation ✔
- Malformed foetus ✔
- Cervix not dilated ✔
- Twisted uterus ✔
- Weak labour ✔
- Diseases ✔
- Twinning/multiple birth ✔
- Hydrocephalus ✔
- Weak muscle contraction ✔
- Prolong gestation ✔
- Vaginal tear ✔

(Any 1) (1)

4.6.4 Hormone that initiates milk release

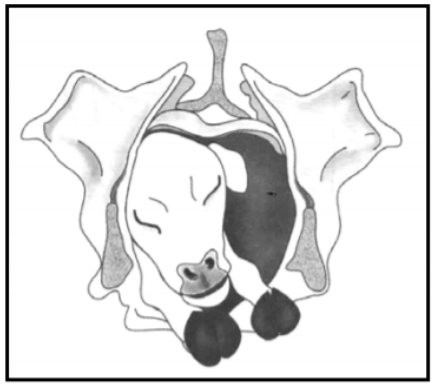
Oxytocin ✔ (1)

4.6.5 First milk produced in the first 3 days after calving

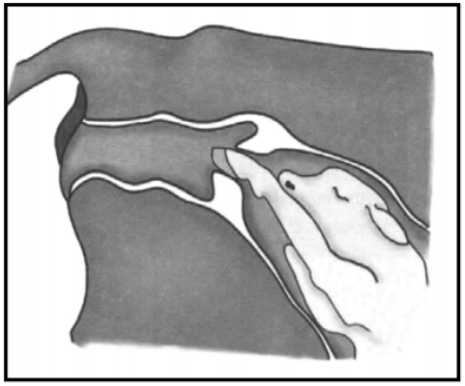
Colostrum/beestings ✔ (1)

Pictures **A** and **B** below represent some stages of parturition in cattle.

4.1



A



B

4.1.1 Name the stages of parturition in picture **A** and picture **B**. (2)

4.1.2 Identify, in picture **A** or **B**, the incorrect positioning of the calf. Give a reason for the answer. (2)

4.1.3 Which picture (**A** or **B**) corresponds to the following activities?

(a) Oxytocin is released to initiate contractions. (1)

(b) Contractions occur every two minutes. (1)

(c) The umbilical cord breaks and the calf starts breathing. (1)

4.1.4 There are noticeable behavioural changes in the cow during stage **B**. Name THREE of these changes. (3)

4.1.1 **Stages of parturition as in pictures A and B**

A - Ejection/expulsion ✓

B - Preparatory ✓ (2)

4.1.2 **Incorrect posture of the calf**

- Picture B/B ✓ (1)

Reason

- Retention of one leg towards the vulva/second leg is folded back ✓ (1)

4.1.3 **Letter that corresponds with the following activities**

(a) B ✓ (1)

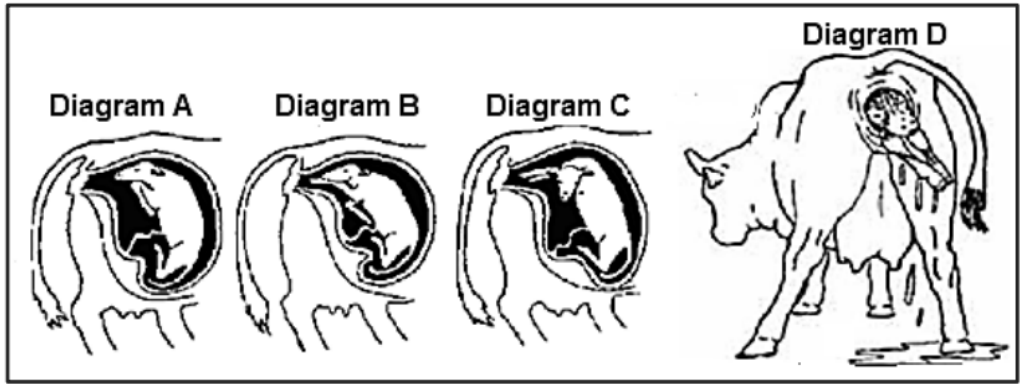
(b) A ✓ (1)

(c) A ✓ (1)

4.1.4 **Behavioural changes**

- Restlessness/walks around/in pain and discomfort ✓
- Loss of appetite ✓
- Isolation/nesting behaviour ✓
- Tail raising ✓
- Lows often/bellowing noises ✓
- Frequent urination ✓ (Any 3) (3)

4.6 The diagrams below represent a cow at different stages of parturition.



4.6.1 Name the stage of parturition represented by DIAGRAMS **A** and **D** respectively. (2)

4.6.2 Provide TWO signs of parturition that could be seen in a cow before stage **D.** (2)

4.6 **Stages of parturition**

4.6.1 **Stages of parturition**
A: Preparatory stage ✓
D: Ejection stage ✓ (2)

4.6.2 **TWO visible signs of parturition**
- Restlessness / walking around ✓
- Urinates and defecates often ✓
- Cow isolates itself ✓
- Vulva enlarges ✓
- String of mucus hangs from the vulva ✓
- Teats tight and swollen / milk drops ✓ (Any 2) (2)

4.6 Parturition is a complicated process and can be problematic especially if presentation of the calf is not correct.

4.6.1 Give the form of presentation represented by each of the statements below:

(a) Foetus lies on its abdomen with forefeet stretching towards the pelvis and the head is resting on it (1)

(b) Rear part of the foetus lies towards the cervix resulting in the hind legs appearing first (1)

4.6.2 Indicate the presentation that will need the assistance of a veterinarian. (1)

4.6.3 Name TWO problems other than presentation that may cause difficult births. (2)

4.6 **Parturition**

4.6.1 **Indication of the form of presentation**

(a) Anterior presentation ✓ (1)
(b) Posterior presentation ✓ (1)

4.6.2 **Presentation that will need vetenary assistance**

- Posterior presentation ✓ (1)

4.6.3 **TWO problems causing difficult birth**

- Deviation of head ✓
- Flection of the elbow ✓
- Retention of one or both forelegs ✓
- Congenital defects/deformities ✓
- Twins ✓ (Any 2 x 1) (2)

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

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

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

4.5 **Parturition**

4.5.1 **TWO behavioural signs of an animal that is about to give birth**

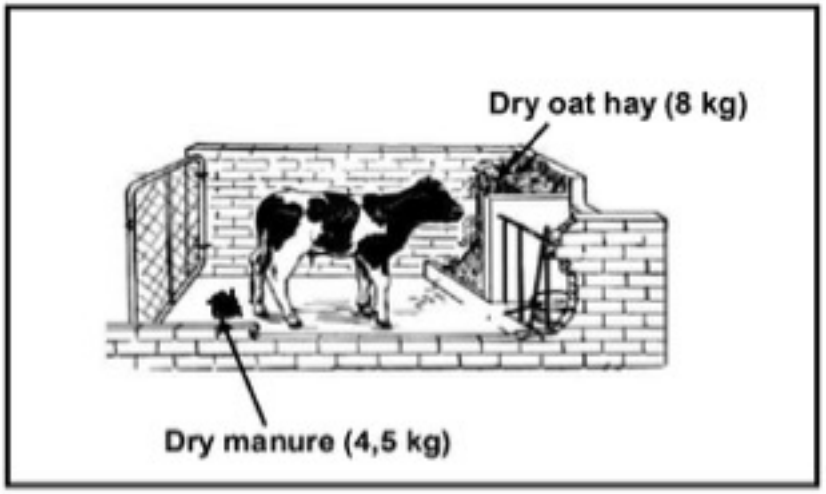
- Isolates herself from the herd ✓
- Loss of appetite ✓
- Show signs of distress and discomfort ✓
- Restlessness ✓
- Nesting behaviour/circles searching for a hiding place ✓
- Frequent urination ✓
- Bellowing noises ✓ (Any 2) (2)

4.5.2 **TWO causes of problems during birth in heifers**

- Large foetus/small sized heifer ✓
- Multiple births ✓
- Inexperience ✓
- Incorrect presentation ✓
- Malformed foetus/hydrocephalous ✓
- Size of the pelvic area ✓
- Incomplete/failure of the cervix to dilate ✓
- Prolonged parturition/ineffective/weak labour ✓
- Inertia of the uterus ✓
- Torsion of the uterus ✓
- Length of the gestation period ✓
- Poor body conformation ✓
- Malnutrition ✓
- Diseases ✓ (Any 2) (2)

DIGESTIBLE CO-EFFICIENT

1.1 The diagram bellow show a farm animal which is used in a feed trial



1.1.1 Use a formula to calculate digestibility coefficience of feed used in the feed trial above. (show all calculations) (4)

1.1.2 Name the substance that could be added to this feed to improve each of the following

(a) Palatability (2)

(b) Protein conted

1.2 In a feed digestibility trial, two ruminant animals were each given 12 kg of dry feed. The dry mass of the manure was determined. The results are shown below.

	ANIMAL A	ANIMAL B
Dry mass of manure (kg)	2	7
Digestible co-efficient (%)	83	?

1.2.1 Calculate the digestibility coefficient of the feed in ANIMAL B. Include the formula. (4)

1.2.2 Name TWO methods by which to increase the digestibility of the feed in ANIMAL B. (2)

1.3 During a digestibility trial, the farmer gave an animal 12 kg of hay and the animal excreted 5 kg dry manure.

1.3.1 Calculate the digestibility co-efficiency of the hay used in this trial.

(Show ALL calculations.) (4)

1.3.2 Suggest ONE supplement that the farmer can use to increase the palatability and digestibility of this hay. (1)

1.4 The table below shows different animal feeds with the percentages of

digestible protein (VP).

FEED	PERCENTAGE OF VP (%)
A. Mieliemeel	9
B. Mielieresteste	4
C. Fishmeal	36

1.4.1 Calculate the ratio in which maize flour and fishmeal must be mixed to obtain a feed with 15% VP. (Show ALL edits.) (4)

1.5 A farm animal ingested 15 kg of hay with a dry matter content of 84% and excreted 3.5 kg of dry manure.

1.5.1 Calculate the digestibility coefficient of the feed in the statement above. (Show ALL calculations.) (5)

2.1 A lamb was given a feed containing 50% total digestible nutrients and 5% digestible protein.

2.1.1 Calculate the nutritive ratio (NR) of this feed. (3)

2.1.2 Comment on the suitability of this feed for its intended purpose. (1)

2.1.3 Provide a reason for your answer in question 2.2.3 (1)

2.2 The table below shows the nutritional composition of two feeds.

COMPOSITION	FEED A	FEED B
Digestible carbohydrates	38%	26%
Digestible protein (DP)	8%	39%
Digestible fat	32%	24%
Nutritive ratio (NR)	1 : 7	1 : 4

2.2.1 Indicate the purpose for which FEED B can be used based on its nutritive ratio. (1)

2.2.2 Give a reason for the answer to QUESTION 2.2.1 (1)

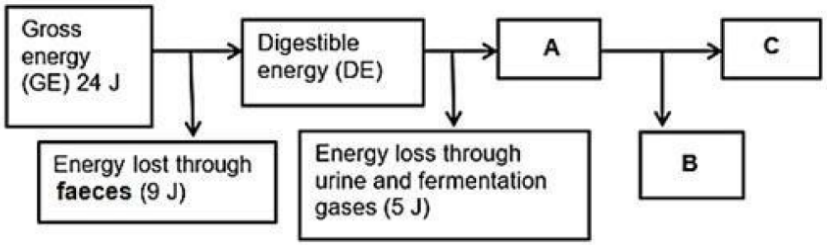
2.2.3 Use the Pearson square method to calculate the ratio into which FEED A and FEED B should be mixed to get a feed with 16% DP. (4)

2.3 The table below shows a feed flow plan used by a farmer.

MONTHS	QUANTITY FEED PRODUCED (kg/month)	FEED REQUIREMENT (kg/month)
1	15 000	20 000
2	20 000	20 000
3	30 000	–
4	40 000	30 000
5	45 000	40 000
6	40 000	42 000

2.3.1 If a farmer has 150 beef cattle and each requires 5 kg of feed a day, calculate, in tons, the total feed requirement during month 3. (Show ALL calculations).

3.1 The flow chart below illustrates the energy values of a feed.



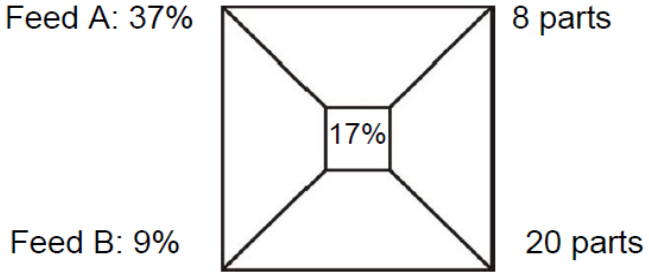
3.1.1 Identify part B (1)

3.1.2 The energy in **C** is important to farm animals. Justify this statement with TWO reasons. (2)

3.3.3 Calculate the energy value represented by **A**. (2)

3.3.4 State TWO aims of calculating energy value of the feed. (2)

4.1 Two feeds (maize meal and sunflower oilcake meal) are mixed to obtain a ration with the desired protein content.



4.1.1 Indicate the parts of the ration that represent maize meal and sunflower oilcake meal. (2)

4.1.2 Calculate the percentage of feed B in the mixture. Show ALL calculations. (3)

4.1.3 Calculate the quantity of maize meal (in kg) in 250 kg of mixture. Show ALL calculations. (2)

4.2 The following are the nutritive ratios of different feeds:

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

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

(a) Animals that are fattened

(b) Lactating animals

(c) Animals that are maintained (3)

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

4.2.3 Feed A is recommended for feeding a one-month-old calf. Justify this statement.

4.3

A farmer used maize meal and sunflower oilcake meal to prepare a ration containing 16% DP. The DP of maize meal is 14% and the DP of sunflower oilcake meal is 45%.

4.3.1 Name a feed formulation method used to prepare a ration that contains a DP of 16% by mixing maize meal and sunflower oilcake meal. (1)

4.3.2 Use the method in QUESTION 2.5.1 to calculate the ratio of maize meal to sunflower oilcake meal. (4)

4.3.3 Calculate the percentage of sunflower oilcake meal in the mixture. (3)

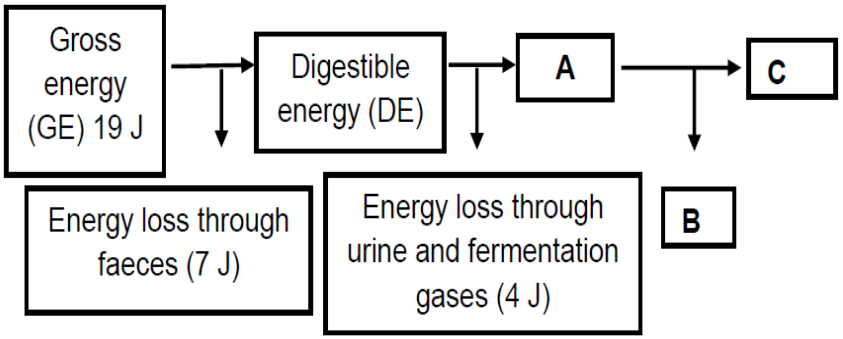
4.4 The table below shows the laboratory results of two feeds.

FEED	TDN (%)	DP (%)	NR
A	75	15	1 : 4
B	80	7	_____

4.4.1 Calculate the nutritive ratio (NR) of feed B. Show ALL calculations, including the formula. (3)

4.4.2 Justify the suitability of feed A and feed B for growing animals based on their nutritive ratios (NR). (2)

4.5 The diagram below shows the energy values of a feed.



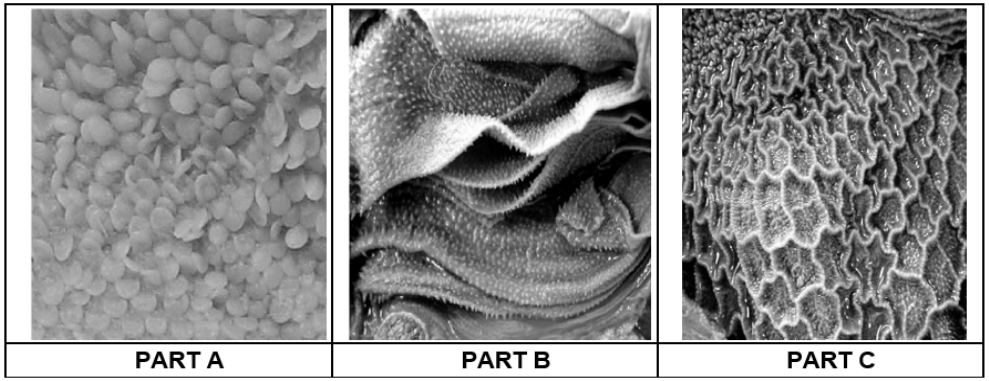
4.5.1 Calculate the energy value represented by A. Show ALL calculations. (2)

4.5.2 Identify the energy loss in B. 1

4.5.3 Give TWO reasons why energy in C is important to farm animals. 2

ALIMENTARY CANAL

1.1 The photographs below show the internal parts in the alimentary canal of ruminants.



PART A	PART B	PART C

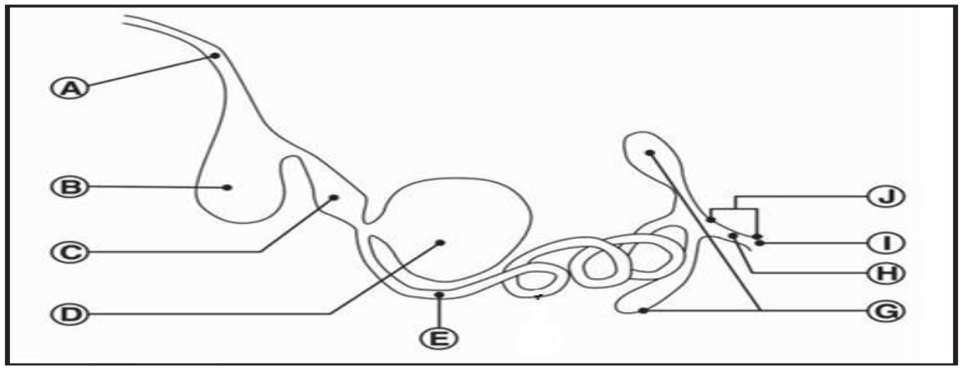
1.1.1 Identify part **B** and part **C.** (2)

1.1.2 Briefly describe ONE function of part **B.** (1)

1.1.3 Name the structures in part A responsible for the production of heat. (1)

1.1.4 State ONE requirement of rumen microbes (1)

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



1.2.1 Identify the type of a farm animal which has an alimentary canal shown in the diagram above (1)

1.2.2 Give TWO reasons visible in the diagram to justify the answer in (2)

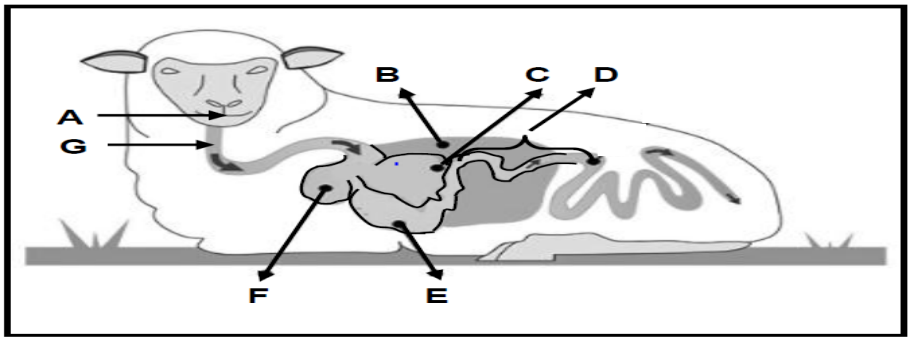
QUESTION 1.2.1

1.2.3 Identify the letter representing the part where the following occurs:

(A) Secretion of gastric juice (1)
(B) Secretion of succus entericus (1)
(C) Grinding of food (1)

1.2.4 Indicate the type of feed that is most suitable for the digestive system of the animal above. (1)

1.3 The picture below shows the alimentary canal of a sheep.



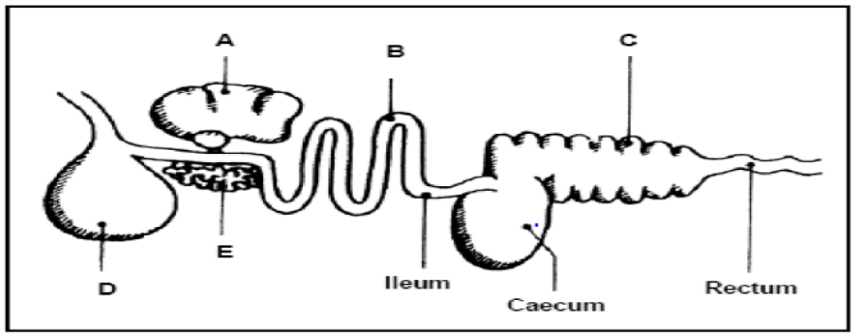
1.3.1 Identify in the picture above only the LETTER of the PART where EACH of the following occurs:

(A) Microbial fermentation (1)
(B) Mechanical digestion (1)
(C) Chemical digestion (1)

1.3.2 Name ONE function of the small intestine. (1)

1.3.3 Compare the structure of the oesophagus in sheep with that of fowl. (2)

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



1.4.1 Name the farm animal whose alimentary canal is represented in the diagram above. (1)

1.4.2 Refer to the diagram to motivate the answer to QUESTION 1.4.1 (1)

1.4.3 Physical and chemical digestion in the alimentary canal of the farm animal named in QUESTION 1.4.1 takes place in the mouth. Justify this statement. (2)

1.5 The diagrams below represent the alimentary canals of farm animals.

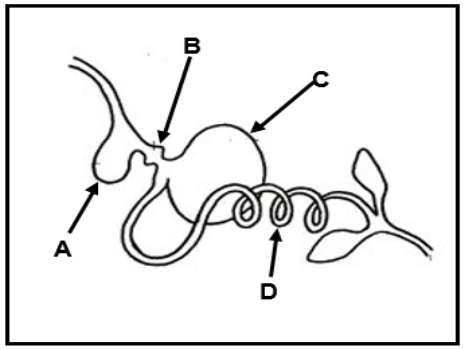


DIAGRAM 1

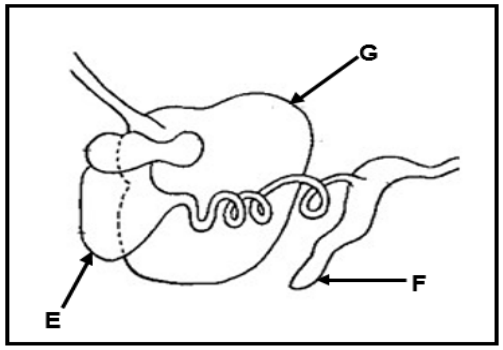


DIAGRAM 2

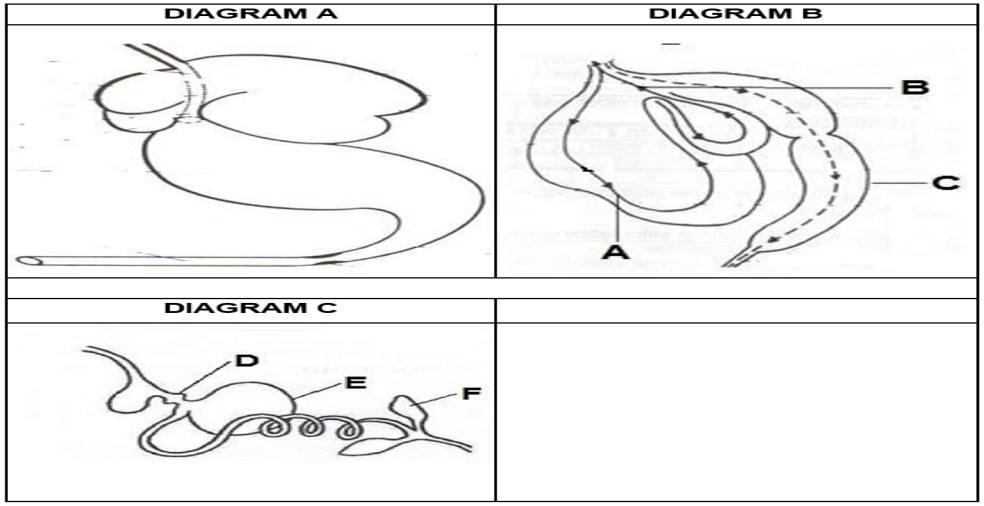
1.5.1 Name the farm animals whose alimentary canals are represented in DIAGRAM 1 and DIAGRAM 2. (2)

1.5.2 Identify the part in DIAGRAM 1 where EACH of the following occurs. Write down only the letter (A–D).

(a) Digestive juices are secreted (1)
(b) Mechanical digestion occurs (1)
(c) Food is moistened and softened (1)

1.5.3 Name TWO adaptations of part G in DIAGRAM 2 which enables the animal to digest feed rich in fibre. (2)

1.6 The diagrams below shows the alimentary canal, stomach and process occurring in the stomach of a farm animal.



1.6.1 Indicate the ages of the animals with a stomach as in DIAGRAM A and DIAGRAM B. (2)

1.6.2 Give a reason visible in DIAGRAM A and DIAGRAM B to justify the answer to QUESTION 1.6.1. (2)

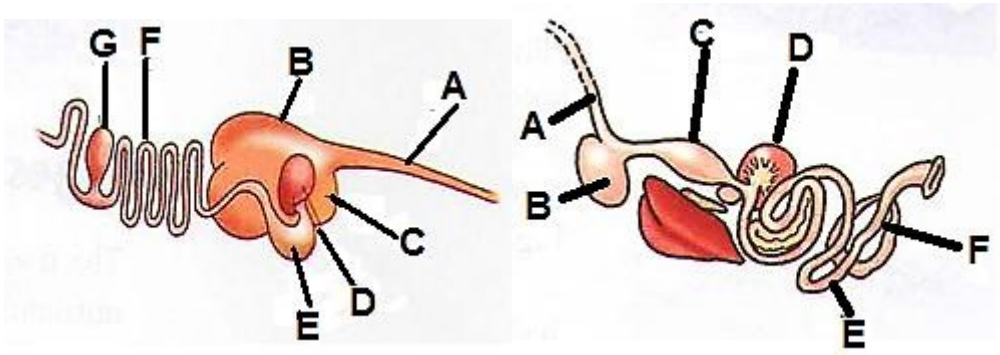
1.6.3 Identify the processes illustrated by arrow A and arrow B in (2)

1.6.4 State the difference of part F in DIAGRAM C with that of a pig. (1)

1.6.5 Identify the letter representing the stomach of the animal in DIAGRAM C that corresponds with part C in DIAGRAM B in terms of functioning. (1)

QUESTION 2: ANIMAL NUTRITION

2.1 The diagrams below show the alimentary canals of different animals.



2.1.1 Indicate a letter that represents the part where the following occurs:

(a) Improperly chewed food land after swallowing in ANIMAL 1 (1)

(b) Food is stored after swallowing in ANIMAL 2 (1)

(c) Rennin and pepsin are secreted in both ANIMAL 1 and 2 (2)

2.1.2 Compare the adaption of part B in ANIMAL 1 and 2 (2

2.2 During a digestibility trial in a feedlot, cattle were fed 240 kg of hay and excreted 14 kg. The table below shows the components of feed consumed and excreted.

FEED COMPONENT	FEED CONSUMED (%)	FEED EXCRETED
Water	10	60
Crude protein	12	8
Ether extract	3	2
Crude fiber	5	7
Ash	3	1
Nitrogen-free extract	65	15

2.2.1 Calculate the digestibility co-efficiency of this hay. (6)

2.2.2 Determine the stage at which this hay was cut. (1)

2.2.3 Suggest a reason for your answer in QUESTION 1.2.2 (2)

2.3 Animal production, protection and control

Read the passage below and answer the question that follows.

Two farmers are specializing in broiler production. Farmers A keeps his broiler in an old house that is oriented in an east-west direction. The roof and walls are well insulated. The house is installed with micro-injectors. The stock density is 28 kg/m². Farmers B uses a steel container which is facing in a northerly direction with poor ventilation. The broilers are kept at a density of 48 kg/m²

2.3.1 Identify the farmer who will have a high mortality rate of broilers

2.3.2 Motivate your answer by giving THREE reason.

2.3.3 Indicate the material or a layout used by farmer A to control the following environmental conditions:

(a) Reducing solar heat penetration on hot days and reducing heat loss on colder days

(b) Reducing the effect of direct sunlight on the walls.

TERMINOLOGY

1.3 Give ONE word/term for each of the following descriptions. Write only the word/term next to the question numbers (1.3.1 to 1.3.5) in the ANSWERBOOK.

1.3.1 The process whereby the partially digested stomach content is returned to the mouth for further chewing

1.3.2 A preventative measure whereby animals with a contagious disease are kept away from healthy animals

1.3.3 A common canal in male animals that is used for excretion of urine and semen

1.3.4 An organelle in the head of a sperm cell which contains genetic materials

1.3.5 A condition where female animals are unable to conceive after several attempts of artificial insemination

1.3.6 The percentage of feed that has not been excreted by an animal

1.3.7 An approach that combines the advantages of modern, traditional and complementary treatment to provide health care for farm animals

1.3.8 The failure of a cow to expel the placenta within 12 to 24 hours after parturition

1.3.9 The process of removing fertilised egg cells from a superior donor cow

1.3.10 The organelle in the mid-piece of a sperm cell supplying energy for movement

1.3.11 The absorption of volatile fatty acids along the concentration gradient through the rumen wall

1.3.12 A preventative measure whereby farm animals with a contagious disease are kept away from healthy animals

1.3.13 The hormone which inhibits milk ejection when a cow is in a scary and unusual situation

1.3.14 A milky, sticky, creamy and opaque liquid released through the penis during ejaculation

1.3.15 A thin-walled elastic tube that extends from the urethral opening to the vulva

1.3.16 The type of animal feed that contains a small volume per unit mass

1.3.17 A permanent handling facility used to restrict the movement of a bull and lead it towards a loading ramp

1.3.18 The process in lactating cows that is stimulated by hormones resulting in the flow of milk

1.3.19 The cell that fuses with the ovum during the process of fertilisation

1.3.20 The transfer of a fertilised ovum from one cow to another

1.3.21 The total amount of energy released as heat when a feed is completely burnt down

1.3.22 An organism that carries a disease-causing agent

1.3.23 The failure of a cow to expel the placenta within 12–24 hours after parturition

1.3.24 The process by which the male reproductive cells are formed

1.3.25 A device placed around the lower leg of a cow to detect her movement and increased activities during oestrus

1.3.26 The measure of the digestibility of a feed expressed as a percentage of the dry matter intake

1.3.27 Oral intake of drugs and medicines to control diseases

1.3.28 The process of depositing semen into the cervix of a female animal without mating taking place

1.3.29 A condition where successful mating occurs but no fertilisation takes place due to congenital defects

1.3.30 The hormone that prepares the uterus to receive the fertilised ovum

1.3.31 The rhythmic contraction and relaxation of the muscles in the alimentary canal for the movement of food

1.3.32 A structure on a farm where animal feeds are stored

1.3.33 Advanced biotechnology used to produce identical offspring from an organism with superior qualities

1.3.34 The changing of the oestrus cycle of all the female animals in a herd so that they come into oestrus at approximately the same time

1.3.35 A sterile female calf born as a non-identical twin of a male calf

1.3.36 A plan where a farmer makes sure that the animal feed requirements are met throughout the production cycle

1.3.37 Poultry equipment in a broiler house that ensures maximum consumption of feed even at night

1.3.38 Parasites that usually live within the digestive tract of an animal

1.3.39 A pregnancy problem caused by excessive collection of fluids in the tissues or between foetal membranes

1.3.40 The process of forming ova in cows

1.3.41 The enzyme in the saliva of pigs responsible for the breaking down of starch to simple sugars

1.3.42 An organism that spends most or part of its life on the host animal

1.3.43 Materials, such as sawdust and straw, which are placed on the floors of pigsties to insulate cold cement floors and absorb moisture

1.3.44 The phenomenon where a superior cow is treated with hormones to produce many ova

1.3.45 The organelle in the mid-piece of the sperm cell that supplies energy for movement

1.3.46 A plan for livestock farmers to ensure that there is enough feed on the farm on an on-going basis to meet animal requirements

1.3.47 A bacterial disease that affects mammary glands

1.3.48 The condition where the testes of male animals remain inside the abdominal cavity

1.3.49 The primary germ layer that surrounds the embryo from which the heart, skeleton and urogenital system develop

1.3.50 The yellow body that is formed in the empty follicle after ovulation, which secretes progesterone

1.3.51 A deficiency symptom in pigs caused by a lack of zinc which results in skin lesions and hair loss.

1.3.52 Equipment fitted with a water valve and a nozzle used to supply water to the sow and piglets

1.3.53 A powerful contraction of the urethra through which semen is deposited into the vagina of a cow

1.3.54 The process of cell division through which the primary spermatocytes divide into secondary spermatocytes

1.3.55 The male reproductive cell that fuses with the ovum during the process of fertilisation

1.3.56 The enzyme in the saliva of pigs responsible for the chemical change from starch to simple sugars

1.3.57 A farmer who produces on a large scale and is profit-orientated

1.3.58 The phenomenon where a superior cow is treated with hormones to produce many ova

1.3.59 A powerful contraction of the urethra that deposits semen into the vagina of the cow

1.3.60 The stage of mating where male and female animals are attracted to one another

1.3.61 The removal of gases from the rumen through the oesophagus to prevent bloating

1.3.62 A specially designed facility used to house a mothering sow enabling her to lie by the side and feed her piglets

1.3.63 The period of milk production in dairy cattle from calving to drying off

1.3.64 Washing out fertilised ova using specialised equipment

1.3.65 The volume of sperm cells in one millilitre of ejaculation

1.3.66 The process of improving the digestibility of grains by dry heating, causing them to expand

1.3.67 When a farm animal maintains a constant body temperature

1.3.68 The phenomenon where a superior cow is treated with hormones to produce many ova

1.3.69 The substance used to control the pH in the dilution of semen

1.3.70 The hormone responsible for the delayed secretion of FSH and oestrogen

1.3.71 A fat-soluble vitamin produced by rumen microbes in ruminant animals

1.3.72 The disease in farm animals, caused by a virus, that leads to aggressive behaviour, bellowing, excessive salivation and paralysis.

1.3.73 The action taken to boost the immune systems of farm animals to prevent them from becoming sick

1.3.74 The stage of pregnancy characterised by cell differentiation into tissues, organs and systems

1.3.75 The hormone released when the udder is washed prior to milking a cow

1.3.76 The substance in urea that may lead to poisoning due to its high concentration levels

1.3.77 A production system where pigs are kept outdoors in a traditional way, where they can move around freely, little attention is paid to them and they are fed waste foods

1.3.78 The failure of a cow to expel the placenta within 12–24 hours after parturition

1.3.79 The process through which the male reproductive cells are formed

1.3.80 The process of removing fertilised egg cells from a superior donor cow

1.3.81 A metabolic disorder resulting from a vitamin B1 deficiency that causes neuromuscular problems

1.3.82 The type of host represented by a snail in the life cycle of a fluke worm

1.3.83 The normal animal birth presentation where the head rests on the feet and the nose is stretched towards the pelvis

1.3.84 The process during which the nucleus of a female egg cell is removed for nuclear transfer

1.3.85 A device that is placed around the lower leg of a cow on heat to detect and record movement

1.3.86 The index used to determine the quality of a protein in a feed.

1.3.87 A mineral deficiency that is responsible for parakeratosis in pigs

1.3.88 A board with handholds that is used to handle pigs

1.3.89 The process whereby eggs are produced by the ovary

1.3.90 The type of cloning used to generate an embryo which is implanted in the uterus of a cow

1.3.91 An alkaline liquid that is produced by the liver and released into the small intestine to assist in the digestion of fats

1.3.92 A technique where curtains are used inside a broiler house to help regulate temperature

1.3.93 The term given to the organism that is responsible for the transmission of viral diseases such as Rift Valley fever

1.3.94 The condition where female animals experience problems during the birth process and need a veterinarian's or the farmer's assistance

1.3.95 The inability of a bull to service cows that are in oestrus even though it has interest

1.3.96 Strategic plan for livestock farmers to ensure that there is enough feed on the farm to meet all the requirements of animals THROUGHOUT the year.

1.3.97 A permanent handling facility used to restrain a bull by its head

1.3.98 A pair of globular glands that look like a cluster of grapes andwhich are the largest secondary sex glands of a bull

1.3.99 The process that results in eggs or ova being formed

1.3.100 An inflammatory bacterial disease that could be acute or chronic and which attacks the udder of a cow

1.3.101 The mineral element needed for normal production of the hormone thyroxin

1.3.102 Gross energy value of a feed minus the energy lost through faeces, urine and digestive gases, as well as the energy lost as heat

1.3.103 A small area where sheep are kept and fed for maximum production output.

1.3.104 The structure that develops on the ovary after ovulation at the position of the burst follicle

1.3.105 The most common bacterial disease that affects the udder and milk production

1.3.106 The digestive gland in the alimentary canal that secretes both digestive juice and hormones

1.3.107 The condition in farm animals caused by a shortage of iron and which leads to paleness

1.3.108 The breeding method where two different types of farm animals mate and produce sterile offspring

1.3.109 The medication injected into an animal to control bacterial infections

1.3.110 The term used to describe a male animal that is interested in a female animal but lacks the ability to serve the female animal

1.3.111 The part of the digestive system of a pig where the most absorption of digested nutrients takes place

1.3.112 The component of a feed that serves as the most important source of heat and energy for an animal

1.3.113 A traditional African custom where a man pays the father of the bride-to-be with cattle

1.3.114 The process through which a Graafian follicle of an ovary bursts to release the ovum

1.3.115 The service rendered by the State where animals are kept in isolation for a particular period while being tested for diseases.

1.3.116 The ratio of digestible protein (DP) :to Digestible non-nitrogenous components (DNNC).

MEMO

1.3 Give ONE word/term for each of the following descriptions. Write only the word/term next to the question numbers (1.3.1 to 1.3.5) in the ANSWER BOOK.

1.3.1 The process whereby the partially digested stomach content is returned to the mouth for further chewing.
REGURGITATION (by reverse peristalsis or retro-peristalsis)

1.3.2 A preventative measure whereby animals with a contagious disease are kept away from healthy animals
QUARANTINE/ ISOLATION

1.3.3 A common canal in male animals that is used for excretion of urine and semen. URETHRA

1.3.4 An organelle in the head of a sperm cell which contains genetic materials. MITOCHONDRIA

1.3.5A condition where female animals are unable to conceive after several attempts of artificial insemination. REPEAT-BREEDER

1.3.6The percentage of feed that has not been excreted by an animal DIGESTIBILTY COEFFICIENT

1.3.7An approach that combines the advantages of modern, traditional and complementary treatment to provide health care for farm animals.
GENERAL ENTERPRISE MANAGEMENT

1.3.8The failure of a cow to expel the placenta within 12 to 24 hours after parturition. RETAINED PLACENTA

1.3.9The process of removing fertilised egg cells from a superior donor cow. EMBRYO FLUSHING

1.3.10 The organelle in the mid-piece of a sperm cell supplying energy for movement. MITOCHONDRIA

1.3.11 The absorption of volatile fatty acids along the concentration gradient through the rumen wall. PASSIVE ABSORPTION/DIFFUSION

1.3.12 A preventative measure whereby farm animals with a contagious disease are kept away from healthy animals. QUARANTINE

1.3.13 The hormone which inhibits milk ejection when a cow is in a scary and unusual situation. ADRENALIN

1.3.14 A milky, sticky, creamy and opaque liquid released through the penis during ejaculation. SEMEN

1.3.15 A thin-walled elastic tube that extends from the urethral opening to the uterus. VAGINA

1.3.16 The type of animal feed that contains a small volume per unit mass. CONCENTRATES

1.3.17 A permanent handling facility used to restrict the movement of a bull and lead it towards a loading ramp. CRUSH / CHUTE

1.3.18 The process in lactating cows that is stimulated by hormones resulting in the flow of milk. MILK EJECTION

1.3.19 The cell that fuses with the ovum during the process of fertilisation. SPERM

1.3.20 The transfer of a fertilised ovum from one cow to another. EMBRYO TRANSFER

1.3.21 The total amount of energy released as heat when a feed is completely burnt down. GROSS ENERGY

1.3.22 An organism that carries a disease-causing agent. VECTOR/CARRIER

1.3.23 The failure of a cow to expel the placenta within 12–24 hours after Parturition. RETAINED PLACENTA

1.3.24 The process by which the male reproductive cells are formed. SPERMATOGENESIS

1.3.25 A device placed around the lower leg of a cow to detect her movement and increased activities during oestrus. PEDOMETER

1.3.26 The measure of the digestibility of a feed expressed as a percentage of the dry matter intake. DIGESTIBILITY COEFFICIENT

1.3.27Oral intake of drugs and medicines to control diseases. DOSING

1.3.28The process of depositing semen into the cervix of a female animal without mating taking place. ARTIFICIAL INSEMINATION/ AI

1.3.29A condition where successful mating occurs but no fertilisation takes place due to congenital defects. STERILITY

1.3.30 The hormone that prepares the uterus to receive the fertilised ovum. PROGESTERONE

1.3.31 The rhythmic contraction and relaxation of the muscles in the alimentary canal for the movement of food. PERISTALSIS

1.3.32 A structure on a farm where animal feeds are stored. SHED

1.3.33 Advanced biotechnology used to produce identical offspring from an organism with superior qualities. CLONING/NUCLEAR TRANSFER

1.3.34 The changing of the oestrus cycle of all the female animals in a herd so that they come into oestrus at approximately the same time. SYCHRONISATION OF OESTRUS

1.3.35 A sterile female calf born as a non-identical twin of a male calf. FREEMARTIN

1.3.36 A plan where a farmer makes sure that the animal feed requirements are met throughout the production cycle. FODDER FLOW

1.3.37 Poultry equipment in a broiler house that ensures maximum consumption of feed even at night. LIGHTING

1.3.38 Parasites that usually live within the digestive tract of an animal. INTERNAL PARASITES/ ENDOPARASITES

1.3.39 A pregnancy problem caused by excessive collection of fluids in the tissues or between foetal membranes. DROPSY

1.3.40 The process of forming ova in cows. OOGENESIS / OVIGENESIS

1.3.41 The enzyme in the saliva of pigs responsible for the breaking down of starch to simple sugars. AMYLASE / PTYALIN

1.3.42 An organism that spends most or part of its life on the host animal. PARASITE

1.3.43 Materials, such as sawdust and straw, which are placed on the floors of pigsties to insulate cold cement floors and absorb moisture. BEDDING

1.3.44 The phenomenon where a superior cow is treated with hormones to produce many ova. SUPEROVULATION

1.3.45 The organelle in the mid-piece of the sperm cell that supplies energy for movement. MITOCHONDRIA

1.3.46 A plan for livestock farmers to ensure that there is enough feed on the farm on an on-going basis to meet animal requirements. FODDER FLOW PLAN

1.3.47 A bacterial disease that affects mammary glands. MASTITIS

1.3.48 The condition where the testes of male animals remain inside the abdominal cavity. CRYPTOCHIDISM

1.3.49 The primary germ layer that surrounds the embryo from which the heart, skeleton and urogenital system develop. MESODERM

1.3.50 The yellow body that is formed in the empty follicle after ovulation, which secretes progesterone. CORPUS LUTEUM

1.3.51. A deficiency symptom in pigs caused by a lack of zinc which results in skin lesions and hair loss. PARAKERATOSIS

1.3.52 Equipment fitted with a water valve and a nozzle used to supply water to the sow and piglets. NIPPLE DRINKERS

1.3.53 A powerful contraction of the urethra through which semen is deposited into the vagina of a cow. EJACULATION

1.3.54 The process of cell division through which the primary spermatocytes divide into secondary spermatocytes. MEIOSIS

1.3.55 The male reproductive cell that fuses with the ovum during the process of fertilisation. SPERM CELL

1.3.56 The enzyme in the saliva of pigs responsible for the chemical change from starch to simple sugars. SALIVARY AMYLASE

1.3.57 A farmer who produces on a large scale and is profit-orientated. COMMERCIAL

1.3.58 The phenomenon where a superior cow is treated with hormones to produce many ova. SUPEROVULATION

1.3.59 A powerful contraction of the urethra that deposits semen into the vagina of the cow. EJACULATION

1.3.60 The stage of mating where male and female animals are attracted to one another. COURTSHIP

1.3.61 The removal of gases from the rumen through the oesophagus to prevent bloating. BELCHING / ERUCTATION

1.3.62 A specially designed facility used to house a mothering sow enabling her to lie by the side and feed her piglets. FARROWING PEN

1.3.63 The period of milk production in dairy cattle from calving to drying off. LACTATION

1.3.64 Washing out fertilised ova using specialised equipment (foley catheter). EMBRYO FLUSHING / EMBRYO HARVESTING

1.3.65 The volume/number/ concentration of sperm cells in one millilitre of ejaculation. SPERM COUNT

1.3.66 The process of improving the digestibility of grains by dry heating, causing them to expand. POPPING

1.3.67 When a farm animal maintains a constant body temperature HOMEOTHERMIC

1.3.68 The phenomenon where a superior cow is treated with hormones to produce many ova. SUPEROVULATION

1.3.69 The substance used to control the pH in the dilution of semen. BUFFER

1.3.70 The hormone responsible for the delayed secretion of FSH and oestrogen. PROGESTERONE

1.3.71 A fat-soluble vitamin produced by rumen microbes in ruminant animals. VITAMIN K

1.3.72 The disease in farm animals, caused by a virus, that leads to aggressive behaviour, frequent bellowing, excessive salivation and paralysis. RABIES

1.3.73 The action taken to boost the immune systems of farm animals to prevent them from becoming sick. VACCINATION

1.3.74 The stage of pregnancy characterised by cell differentiation into tissues, organs and systems. EMBRYO PHASE

1.3.75 The hormone released when the udder is washed prior to milking a cow. OXYTOCIN

1.3.76. The substance in urea that may lead to poisoning due to its high concentration levels. AMMONIA

1.3.77 A production system where pigs are kept outdoors in a traditional way, where they can move around freely, little attention is paid to them and they are fed waste foods. FREE-RANGE

1.3.78 The failure of a cow to expel the placenta within 12–24 hours after parturition. RETAINED PLACENTA

1.3.79 The process through which the male reproductive cells are formed OOGENESIS/ OVIGENESIS

1.3.80. The process of removing fertilised egg cells from a superior donor cow. EMBRYO FLSHING

1.3.81 A metabolic disorder resulting from a vitamin B1 deficiency that causes neuromuscular problems. POLYNEURITIS

1.3.82 The type of host represented by a snail in the life cycle of a flukeworm. INTERMEDIATE

1.3.83 The normal animal birth presentation where the head rests on the feet and the nose is stretched towards the pelvis. ANTERIOR

1.3.84 The process during which the nucleus of a female egg cell is removed for nuclear transfer. ENUCLEATION

1.3.85 A device that is placed around the lower leg of a cow on heat to detect and record movement. PEDOMETER

1.3.86 The index used to determine the quality of a protein in a feed. BIOLOGICAL VALUE / BV

1.3.87 A mineral deficiency that is responsible for parakeratosis in pigs. ZINC

1.3.88 A board with handholds that is used to handle pigs. PLYWOOD BOARD

1.3.89. The process whereby eggs are produced by the ovary. OOGENESIS

1.3.90. The type of cloning used to generate an embryo which is implanted in the uterus of a cow. REPRODUCTIVE CLONING

1.3.91 An alkaline liquid that is produced by the liver and released into the small intestine to assist in the digestion of fats. BILE

1.3.92 A technique where curtains are used inside a broiler house to help regulate temperature. INSULATION / VENTILATION

1.3.93 The term given to the organism that is responsible for the transmission of viral diseases such as Rift Valley fever. VECTOR

1.3.94 The condition where female animals experience problems during the birth process and need a veterinarian's or the farmer's assistance.
DYSTOCIA

1.3.95 The inability of a bull to service cows that are in oestrus even though it has interest. IMPOTENCE

1.3.96 Strategic plan for livestock farmers to ensure that there is enough feed on the farm to meet all the requirements of animals for a period of one year. FODDER FLOW

1.3.97 A permanent handling facility used to restrain a bull by its head. HEAD CLAMP

1.3.98 A pair of globular glands that look like a cluster of grapes and which are the largest secondary sex glands of a bull.
SEMINAL VESICLES / VESCULAR GLANDS

1.3.99 The process that results in eggs or ova being formed. OVIGENESIS

1.3.100 An inflammatory bacterial disease that could be acute or chronic and which attacks the udder of a cow. MASTITIS

1.3.101 The mineral element needed for normal production of the hormone thyroxin. IODINE

1.3.102 Gross energy value of a feed minus the energy lost through faeces, urine and digestive gases, as well as the energy lost as heat. NET ENERGY

1.3.103 A small area where sheep are kept and fed for maximum production output. FEEDLOT

1.3.104 The structure that develops on the ovary after ovulation at the position of the burst follicle. CORPUS LUTEUM

1.3.105 The most common bacterial disease that affects the udder and milk production. MASTITIS

1.3.106. The digestive gland in the alimentary canal that secretes both digestive juice and hormones. PANCREAS

1.3.107 The condition in farm animals caused by a shortage of iron and which leads to paleness. ANAEMIA

1.3.108 The breeding method where two different types of farm animals mate and produce sterile offspring. SPECIES CROSSING

1.3.109 The medication injected into an animal to control bacterial infections. ANTIBIOTICS

1.3.110 The term used to describe a male animal that is interested in a female animal but lacks the ability to serve the female animal. IMPOTENCE

1.3.111 The part of the digestive system of a pig where the most absorption of digested nutrients takes place. SMALL INTESTINES

1.3.112 The component of a feed that serves as the most important source of heat and energy for an animal. CARBOHYDRATES

1.3.113 A traditional African custom where a man pays the father of the bride-to-be with cattle. LOBOLA/DOWRY

1.3.114 The process through which a Graafian follicle of an ovary bursts to release the ovum. OVULATION

1.3.115 The service rendered by the State where animals are kept in isolation for a particular period while being tested for diseases. QUARANTINE

1.3.116 The ratio of digestible protein (DP) to Digestible non-nitrogenous components (DNNC). NUTRITIVE RATIO