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| **AGRICULTURAL SCIENCES P1**  **MOCK EXAMINATION ON ANIMAL NUTRITION**  **MARKING GUIDELINES**  **FEB-MAR 2017** | | | | |
| **MARKS:** | | **200** | | |
| **SECTION A** | | | |  |
| **QUESTION 1** | | | |  |
| 1.1 | |  | | |
|  | | 1.1.1 | A |  |
|  | | 1.1.2 | D |  |
|  | | 1.1.3 | B |  |
|  | | 1.1.4 | D |  |
|  | | 1.1.5 | C |  |
|  | | 1.1.6 | D |  |
|  | | 1.1.7 | D |  |
|  | | 1.18 | B |  |
|  | | 1.1.9 | D |  |
|  | | 1.1.10 | A |  |
|  | | 1.1.11 | D |  |
|  | | 1.1.12 | D |  |
|  | | 1.1.13 | A |  |
|  | | 1.1.14 | C |  |
|  | | 1.1.15 | C |  |
|  | | 1.1.16 | D |  |
|  | | 1.1.17 | B |  |
|  | | 1.1.18 | A |  |
|  | | 1.1.19 | B |  |
|  | | 1.1.20 | C |  |
|  | | 1.1.21 | D |  |
|  | | 1.1.22 | C |  |
|  | | 1.1.23 | B |  |
|  | | 1.1.24 | A |  |
|  | | 1.1.25 | C |  |
|  | | 1.1.26 | A |  |
|  | | 1.1.27 | B |  |
|  | | 1.1.28 | C |  |
|  | | 1.1.29 | D |  |
|  | | 1.1.30 | C |  |
|  | | 1.1.31 | D |  |
|  | | 1.1.32 | A |  |
|  | | 1.1.33 | C |  |
|  | | 1.1.34 | C |  |
|  | | 1.1.35 | D |  |
|  | | 1.1.36 | A |  |
|  | | 1.1.37 | D |  |
|  | | 1.1.38 | B |  |
|  | | 1.1.39 | A |  |
|  | | 1.1.40 | C |  |
|  | | 1.1.41 | A |  |
|  | | 1.1.42 | B |  |
|  | | 1.1.43 | C |  |
|  | | 1.1.44 | A |  |
|  | | 1.1.45 | D |  |
|  | | 1.1.46 | C |  |
|  | | 1.1.47 | D |  |
|  | | 1.1.48 | A |  |
|  | | 1.1.49 | B |  |
|  | | 1.1.50 | A |  |
|  | | 1.1.51 | C |  |

|  |  |  |  |
| --- | --- | --- | --- |
| 1.2 | 1.2.1 | B only |  |
|  | 1.2.2 | B only |  |
|  | 1.2.3 | B only |  |
|  | 1.2.4 | B only |  |
|  | 1.2.5 | A only |  |
|  | 1.2.6 | Both A and B |  |
|  | 1.2.7 | Both A and B |  |
|  | 1.2.8 | A only |  |
|  | 1.2.9 | None |  |
|  | 1.2.10 | A only |  |
|  | 1.2.11 | B only |  |
|  | 1.2.12 | A only |  |
|  | 1.2.13 | Both A and B |  |
|  | 1.2.14 | B only |  |
|  | 1.2.15 | B only |  |
|  | 1.2.16 | None |  |
|  | 1.2.17 | B only |  |
|  | 1.2.18 | B only |  |
|  | 1.2.19 | A only |  |
|  | 1.2.20 | None |  |
|  | 1.2.21 | Both A and B |  |
|  | 1.2.22 | B Only |  |
| 1.3 |  |  |  |
|  | 1.3.1 | Oesophogeal groove |  |
|  | 1.3.2 | Cellulolytic organisms |  |
|  | 1.3.3 | Red |  |
|  | 1.3.4 | Biological value |  |
|  | 1.3.5 | Zinc/Zn |  |
|  | 1.3.6 | Plywood |  |
|  | 1.3.7 | Juicy roughage |  |
|  | 1.3.8 | Mineral lick |  |
|  | 1.3.9 | Feedlot |  |
|  | 1.3.10 | Docking |  |
|  | 1.3.11 | Pyloric sphincter |  |
|  | 1.3.12 | Proventriculus / gland stomach |
|  | 1.3.13 | Gross domestic product |  |
|  | 1.3.14 | Pancreas |  |
|  | 1.3.15 | Retained placenta |  |
|  | 1.3.16 | Iodine |  |
|  | 1.3.17 | net energy |  |
|  | 1.3.18 | Biological value/ BV |  |
|  | 1.3.19 | Vitamin K/Phylloquinone |  |
|  | 1.3.20 | Zinc, ZN |  |
|  | 1.3.21 | Polyneuritis |  |
|  | 1.3.22 | Bile |  |
|  | 1.3.23 | Fodder flow/Feed flow |  |
|  | 1.3.24 | Amylase/ptyalin |  |
|  | 1.3.25 | Pedometer |  |

|  |  |  |
| --- | --- | --- |
| 1.4 |  |  |
|  | 1.4.1 | Iodine |
|  | 1.4.2 | Popping |
|  | 1.4.3 | Tranquilisers |
|  | 1.4.4 | Pearson square |
|  | 1.4.5 | Maintenance ration |
|  | 1.4.6 | Rectum |
|  | 1.4.7 | Villus |
|  | 1.4.8 | High |
|  | 1.4.9 | Weaning |
|  | 1.4.10 | Peristalsis |
|  | 1.4.11 | Fats |
|  | 1.4.12 | Person square |
|  | 1.4.13 | Maintenance |
|  | 1.4.14 | Rectum |
|  | 1.4.15 | Silage |
|  | 1.4.16 | Zinc/Zn |
|  | 1.4.17 | Person squire |
|  | 1.4.18 | Cardiac |
|  | 1.4.19 | Mechanical/Physical |
|  | 1.4.20 | Cafeteria style/free choice |
|  | 1.4.21 | fodder flow/feed flow |
|  | 1.4.22 | feed conversion ratio |
|  |  |  |

**SECTION B**

**QUESTION 2: ANIMAL NUTRITION**

2.1 **Alimentary canal of poultry**

2.1.1 **Identification of the parts**

1. - Crop √ (1)
2. - Proventriculus/glandular stomach √ (1)
3. - Ventriculus/gizzard/muscular stomach √ (1)

2.1.2 **Letter of the part that contains small stones**

C √ (1)

2.1.3 **Reason for the presence of stones**

Helps with mechanical digestion/grinding of the food √ (1)

2.1.4 **Parts of the alimentary canal of poultry that will not be found**  **in sheep**

* Crop/A √
* Proventriculus/B √
* Gizzard/ventriculus/C √
* Cloaca/vent/uro-genital opening/E √
* Caeca/D √ (Any 2) (2)

2.2 **Composition of feed intake and excreted by a calf consuming 5kg**

* + 1. **Feed component with lowest absorption rate**

Crude fibre √(1)

* + 1. **TWO reasons for the answer**

• Has the highest rate of excretion √

* Fore stomachs/rumen not well developed/not functional√
* Absence/limited quantities of rumen micro flora√ (Any 2)(2)

2.2.3 **ONE reason for not recommending it for dairy cows**

* Crude protein concentration is too low/5%√
* Crude fibre concentration is too high/78% √ (Any 1)(1)

2.2.4 **Calculate dry material (DM) in the feed (kg)**

* (15% moisture) 0,15 x 5kg = 0,75kg moisture

• 5kg – 0,75 = 4,25kg DM

**OR**

* (85% DM) 0,85 x 5kg

• = 4,25kg DM (2)

2.3 **Pearson square method (Information on two feeds)**

2.3 2.3.1 **Calculate percentage**

1. **Maize meal**

31 x 100

33

= 93,93% (2)

1. **Soybean meal**

2 x 100

33

= 6,06% (2)

2.3.2 **Cost of soybean in the ration**

* 0,0606 (6,06%) x 285kg = 17,27kg

• 17,27kg x R4,58 per kg

* = R79,10 (3)

2.4 **Biological value (BV) data**

2.4.1 **Explanation of biological value**

• BV is an index of the % of nitrogen in a certain feed √

* It reflects the quality of protein in the feed √
* It is determined by the amino acid composition√
* and the ratio of amino acids in the protein√ (Any 2) (2)

2.4.2 **Relation between the BV and the quality of a feed**

• The higher the BV √

* The better the quality of a feed √

**OR**

* The lower the BV √
* The lower the quality of a feed √ (2)

**2.4.3 Identification of feed with the lowest BV**

Maize meal √ (1)

**2.2.4 Determination of suitability of maize meal**

* Suitable for energy/fattening√
* Not suitable for production/growth/reproduction (Any 1)(1)

2.2.5 **Importance of feeding pigs feed with high BV**

• They are not able to produce their own amino acids √

* They need to be fed protein directly √(2)

2.5 **Fodder flow planning**

2.5.1 **Calculate the:**

1. **Quantity of Fescue (t DM/Ha)** 
   * 210 t/year ÷ 15 Ha√ = 14t DM/Ha √ (2)
2. **Ha planted with maize for silage** 
   * 100 t/year ÷ 10 t/Ha = 10 Ha √ √ (2)

2.5.2 **Fodder crop best utilized for:**

1. **Summer grazing**

• Kikuyu (pasture) √

1. **Succulent crop during the winter**

• Maize/silage/ √

1. **Most economic hay**

• Fescue √ (3)

**QUESTION 2: ANIMAL NUTRITION**

2.1 A representation of the alimentary canal of a farm animal.

2.1.1 **Farm animal represented by the alimentary canal**

Pig√

2.1.2 Importance of parts A and C

|  |  |
| --- | --- |
| A — Assists in chemical and mechanical digestion of food√ | (1) |
| C — Assists in chemical digestion and absorption of food√  2.1.3 Explanation of mechanical digestion  Breaking down of the complex food particles into smaller, simpler particles s/√ | (1) |
| through physical means/teeth/chewing/mastication/chuming  2.2 The absorption of nutrients from the small intestines  2.2.1 Identification of transport | (2) |
| A — Active absorption/carrier molecule theory  B — Passive absorption/osmosis/diffusion  2.2.2 Reason  Active absorption e Nutrients move from a lower concentrated area to a higher concentrated area/against the concentration gradient through an energy carrier (ATP)  Passive absorption  Nutrients move from a higher concentrated area to a lower | (1) |
| concentrated area/aiong the concentration gradient  2.2.3 Identification of the structure labelled C | (2) |
| Differential permeable 'partially/semi-permeable membrane  22.4 Nutrient absorbed through  (a) Blood capillaries Digested protein/carbohydrates/ amino acids glucose/vitamins/minerals | (1) |
| (b) Lacteal Digested fats/glycerol and fatty acids  2.3 The various feed components of a ration  2.3.1 Example of an energy rich concentrate | (1) |
| Maize meal | (1) |

2.3.2 Feed supplement acting as a source of energy in licks

Molasses

2.3.3 Suitability of urea for pigs

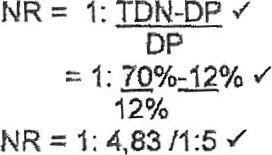
 Not suitable 

Reason

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | It cannot be digested by pigs/pigs are monogestric/only ruminant animals can utjlise | (2) | | |
| 2.3.4 | Tabulation of rations |  | | |
| |  |  | | --- | --- | | SOURCE OF PROTEIN | EXAMPLE | | Natural protein | Lucerne hay (1) | | NPN | Urea (1) |   Table (3)  2.4 Fodder flow programme  2.4.1 Completion of the table   1. 600 x 120=72 v = 72 tons   1000   1. 200 x 120=240Q v = 24 tons | | | |  |
| 1000  24.2 Determining the average cost to feed ONE animal for ONE day  RI 14 277,80 + 113 animals  = R1011,31 + 120 days | | | | (4) |



|  |  |  |
| --- | --- | --- |
|  | RI 14 277180 + 120 days  = R952,32 + 113 animals |  |
|  | R8143 | (3) |
| 2.5 | Composition of two animat feeds  2.5.1 Calculating nutritlve ration (NR) of FEED B  NR = 1: % digestible non-nitrogen nutrients % digestible protein |  |

 (3)

2.5.2 Justification for not recommending feed A

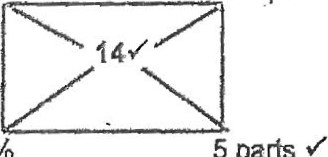
* Wide nutritive ratio 
* It has more carbohydrates and fats than proteins /fewer proteins (2) than carbohydrates and fats«Agr)cultural

2.6 Pearson square method

Calculating Pearson square

Oats meal 9% 24 parts v'

Sunflower 38%



5

parts

|  |  |
| --- | --- |
| Ratio of oats : sunflower is 24:5 | (4)  (35 |

**QUESTION 2: ANIMAL NUTRITION**

2.1 **Alimentary canal of farm animals**

2.1.1 **Identification of a non-ruminant animal**

* Animal 2 √ (1)

2.1.2 **Reason**

It does not have a complex stomach/has simple stomach √ (1)

2.1.3 **Type of feed in ration of animal 1**

Roughage√ (1)

2.1.4 **ONE reason for the feeding a roughage**

* Has a higher crude fibre/cellulose content needed for the

activity of rumen micro flora√(1)

2.1.5 **Letter representing a part enabling the digestion of roughage**

* A √(1)

2.1.6 **Explanation of the role of parts D and E in digestion**

* **Part D** **–** Contains enzymes fordigestion of grain feed √(1)

• **Part E –** Helps to soften and moistens grain feed√(1)

2.2 **Energy flow in an animal**

2.2.1 **Completion of representation**

* **A** – Metabolic energy √(1)
* **B** – Faeces √ (1)
* **C** – Body Heat√(1)

* + 1. **Energy as final combustion heat released during oxidation**

GE/Gross energy √ (1)

* + 1. **Formula to work out digestible energy**

DE = gross energy – energy lost in faeces √ (1)

* + 1. **TWO reasons for the importance of net energy**
* Needed for production√
* Needed for maintenance√ (2)

2.3 **Biological values of feeds**

2.3.1 **Feeds and reasons**

1. Fishmeal √ (1)

**Reason**

It has the highest BV(90)/essential amino acids needed for

growth√ (1)

1. Maize√ (1)

**Reason**

It is has the highest energy value/energy value of 80 that is needed

for fattening√ (1)

1. Barley √ (1)

**Reason**

They need feed with a low BV/BV of 50/energy value of 60%

necessary for maintenance √ (1)

2.3.2 **Reason for high BV in lucerne over barley**

• Lucerne is a legume crop that is rich in proteins √

• Barley is a non-legume which is poor in proteins/rich in

carbohydrates √(2)

2.4 **Fodder flow programme**

2.4.1 **Total feed needed for the year:**  **Need for the dry season**

Need per animal/day x number of animals x 30 days x 6 months

* + - * 15 kg x 30 animals x 30 days x 6 months √

• = 81 000 kg √

**Need for the whole year** = Rainy season need + Dry season need

* + - * 108 000 kg + 81 000 kg = 189 000 kg √ (3)

2.4.2 **Total amount available for the dry season**

• 0,15 x 1000 x 42 x 6 √

• = 37 800 kg √ (2)

**2.4. 3Feed flow problem for the farmer during the dry season**

Need of feed exceeds the available resources/shortage as 37 800 kg √ available compared to 81 000 kg need for the animals √ (2)

* + 1. **Sustainable measure to correct the shortage** 
       - Cutting fodder during rainy season√
       - Storage of fodder for dry season √
       - Culling/stock reduction √ (Any 1) (1)

2.5 **Balanced ration**

2.5.1 **Amounts of maize and sunflower oilcake in 600kg**

• Maize = 61.29 x 600 kg √

100

= 367.74 kg √

• Sunflower oilcake = 38.71 x 600 kg √

100

= 232.26 kg √ (4)

2.5.2 **Feed constituting 19 parts**

Maize meal √ (1)

**[35]**

**SECTION B**

**QUESTION 2: ANIMAL NUTRITION**

2.1 **Alimentary canal of fowls**

2.1.1 **Identify**

**A –** Crop √

B **–** Duodenum/small intestine √

**E –** Pancreas √ (3)

2.1.2 **Ways in which structure C is adapted**

* Thick, muscular walls for grinding feed √
* Presence of small stones for grinding feed √(2)

2.1.3 **Identification of structure B and estimation of pH**

* Proventriculus/truestomach/glandular stomach √
* pH less than 7/acidic √(2)

2.2 **A schematic representation of the components of feeds**

2.2.1 **Identification of substances**

1. **–** Dry matter/DM √
2. **–** Inorganic matter/minerals/elements/ash components √
3. **–** Vitamins √ (3)

2.2.2 **Distinction between oil and fat**

**Oil –** Unsaturated/liquid at room temperature/plant origin √

**Fat –** Saturated/solid at room temperature/animal origin √ (2)

2.2.3 **End-products of digestion**

1. **Carbohydrate –** Glucose/energy √
2. **Protein –** Amino acids √(2)

2.3 **Fodder flow programme**

2.3.1 **Difference in feed requirement against the available feed for**

**September**

Feed requirement 66 tons – feed available 54 tons

= 12 tons deficit/shortage √ (1)

**January**

Feed requirement 49 tons – feed available 78 tons

= 29 tons surplus/excess √(1)

2.3.2 **Calculation of the total DM available for B**

40 + 35 + 54 + 46 + 17 + 30 + 20 + 10 + 10 + 32

= 294 tons √(2)

2.3.3 **The month when the veld supplied 15 tons of fodder**

February √(1)

2.4 **Co-efficient of digestibility of green lucerne**

2.4.1 **Determination of the co-efficient of digestibility of the green** **lucerne**

DC = Dry matter intake (kg) – dry matter excreted (kg) x 100 √ dry matter intake (kg) 1

= DM intake 2,5 kg x 0,6 = 1,5 kg moisture

2,5 kg – 1,5 kg = 1,0 kg DM√

**OR**

DM intake 2,5 kg x 0,4 = 1,0 kg DM

= 1,0 kg – 0,255 kg x 100  √

1,0 kg 1

= 74,5 √% √ (5)

2.4.2 **Specific nutrient which fits each of the following descriptions:**

1. Iron/Fe √
2. Cobalt/Co √
3. Vitamin B2/riboflavin √
4. Calcium/Ca (√4)

2.5 **Data representing the laboratory results of THREE feed**

2.5.1 **Calculation of the NR for feed 2**

NR = 1: TDN% - DP% √

DP%

= 1: 75% - 15% √ OR = 1: 60% √

15% 15%

NR = 1: 4 √ (3)

2.5.2 **Identification of the feed (1, 2 or 3) recommended**

• Feed 2 √ (1)

2.5.3 **Reason to justify the answer in QUESTION 2.5.2**

* It has a narrower nutritive ratio √
* Suggesting a comparatively higher protein necessary for milk production √ (Any 1)(1)

2.5.4 **The cheapest feed**

Feed 3 √(1)

2.5.5 **Reason for the answer in QUESTION 2.5.4**

* This feed has a lower protein content √
* Feed with lower protein is cheap √ (Any 1)(1)

**AGRICULTURAL SCIENCES P1**

**MOCK EXAM**

**MARKING GUIDELINES**

**MARKS: 200**

**SECTION A**

**QUESTION 1**

1.1

1.1.1 A

1.1.2 D

1.1.3 A

1.1.4 D

1.1.5 C

1.1.6 D

1.1.7 A

1.1.8 C

1.1.9 D

1.1.10 B

1.1.11 C

1.1.12 B

1.1.13 D

1.1.14 B

1.1.15 D

1.1.16 B

1.1.17 C

1.1.18 A

1.1.19 C

1.1.20 C

1.1.21 A

1.1.22 D

1.1.23 A

1.1.24 A

1.1.25 C

1.1.26 B

1.1.27 D

1.1.28 C

1.1.29 A

1.1.30 B

1.1.31 C

1.1.32 C

1.1.33 D

1.1.34 A

1.1.35 B

1.1.36 D

1.1.37 D

1.1.38 D

1.1.39 B

1.1.40 C

1.2

1.2.1 B only

1.2.2 None

1.2.3 B only

1.2.4 None

1.2.5 B only

1.2.6 B only

1.2.7 None

1.2.8 None

1.2.9 A only

1.2.10 None

1.2.11 A only

1.2.12 A only

1.2.13 None

1.2.14 B only

1.2.15 Both A and B

1.2.16 A only

1.2.17 A only

1.2.18 B only

1.2.19 A only

1.2.20 A only

1.2.21 None

1.2.22 A only

1.1.23 A only

1.1.24 A only

1.3

1.3.1 Cryptorchidism

1.3.2 Embryo flushing

1.3.3 Futhi

1.3.4 Meiosis

1.3.5 Freemartin/Queen

1.3.6 Oogenesis/Ovigenesis

1.3.7 Reproductive cloning

1.3.8 Alveoli

1.3.9 Amnion

1.3.10 Graafian follicle

1.3.11 Hypoplasia

1.3.12 Impotence

1.3.13 Oxytocin

1.3.14 Ejaculation

1.3.15 Colostrum

1.3.16 Superovulation

1.3.17 Ejaculation

1.3.18 Courtship

1.3.19 Corpus Luteum

1.3.20 Oogenesis/Ovigenesis

1.3.21 reproductive cloning

1.3.22 Embryonic

1.3.23 Oxytocin

1.3.24 seminal vesicle/vascular gland

1.3.25 Oogenesis/Ovigenesis

1.3.26 Dystocia

1.3.27 impotence

1.3.28 Anterior

1.4

1.4.1 Acrosome

1.4.2 Embryo transfer

1.4.3 Oestrus

1.4.4 Ovaries

1.4.5 Sterility

1.4.6 Furrowing

1.4.7 Super-ovulation

1.4.8 Umbilical cord

1.4.9 Embryonic phase

1.4.10 miscarriage

1.4.11 Anti-bodies

1.4.12 Scrotum

1.4.13 Hialuronidase

1.4.14 Embryo transfer

1.4.15 Monozygotic/Identical

1.4.16 Dry

1.4.17 Cloning/Nuclear transfer

1.4.18 ovum/egg/female reproductive/sex cell/gametes

1.4.19 Synchronization

1.4.20 Mesoderm

1.4.21 Donor/Superior

1.4.22 Dry

1.4.23 Prolapsed vagina/Prolapse

|  |  |  |  |
| --- | --- | --- | --- |
| **QUESTION 4** | | | |
| 4.1 | **Embryo and foetus development:** | | |
|  | 4.1.1 | **Identification of the structure:** |  |
|  |  | (a) B – Allantois ✓  (b) E – Foetus ✓  (c) F Umbilical cord / Placenta ✓ | (3) |
|  | 4.1.2 | **Provision of the following:** |  |
|  |  | 1. **One Function:** |  |
|  |  | * Protection of the foetus against shock / shock absorbers ✓ * Prevents desiccation / dehydration / drying of the foetus ✓ * Lubrication of birth canal ✓ * Regulates temperature around the foetus ✓ * Prevents foetus from attaching to other tissues ✓ (Any 1) | (1) |
|  |  | 1. **One constituent of D:** |  |
|  |  | * Amniotic fluid / water / liquid ✓ | (1) |
|  |  | 1. **Place where D:** |  |
|  |  | * Inside amnion / C ✓ | (1) |
|  | 4.1.3 | **Time to detect rectal pregnancy:** |  |
|  |  | 3 – 4 months during pregnancy / gestation ✓ | (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 veins to specific parts/target organ of the body  performing specialised functions |  |
|  | 4.2.2 | **Primary function of hormones:** |  |
|  |  | 1. **Testesterone:** |  |
|  |  | |  | | --- | | * Development of the secondary maie characteristics * Enhances sexual desire * Stimulates sperm production (Any 1) | |  | | (1) |
|  |  | 1. **Luitenising 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) |
|  |  | 1. **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 * 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:**   * Maintaining the corpus luteum — Progesterone * Growth and development of Graafian follicles - FSH | (2) |
| 4.3 | **Oestrus cycle of dairy cattle:** | |  |
|  | 4.3.1 | **Determination of the number of cows on oestrus:**   * 10 cows | (1) |
|  | 4.3.2 | **Indication of time 20 cows will be in oestrus:**   * 18:00 to 00:00 | (1) |
|  | 4.3.3 | **Tendency of cows in oestrus from 12:00 to 06:00:**   * Increased number/higher / more from 10 to 45 cows | (1) |
|  | 4.3.4 | **The number of cows in oestrus from 18:00 to 06:00:**   * 20 cows + 45 cows = 65 COWS | (2) |
|  | 4.3.5 | **Best time to inseminate:**   * 12:00 - 18:00/in the afternoon | (1) |
|  | 4.3.6 | **Reason:**   * Time when most (45 cows) are in oestrus/on heat | (1) |
| 4.4 | **The udder of a dairy cow:** | |  |
|  | 4.4.1 | **Identification of the parts:**   * A – Alveolus * B – Lobe * C – Teat | (3) |
|  | 4.4.2 | **Definition of lactation:**   * Period of milk production by female animals/cows * Starting soon after parturition for an average of 305 days * Involves the hormone prolactin and oxytocin (Any 2) | (2) |
|  | 4.4.3 | **Comparison of milk and butterfat production:**   * Milk production increases until peak period thereafter it decreases * Butterfat production decreases until peak period thereafter it increases | (2) |
| 4.5 | **Difficult births:** | |  |
|  | 4.5.1 | **Scientific term for difficult births:**   * Dystocia | (1) |
|  | 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 the 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 smali 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/complicaüons (Any 2) | (2) |

**QUESTION 4: ANIMAL REPRODUCTION**

**4.1 The parts labelled A, C and E**:

4.1.1 A ‒ Ovary 

C ‒ Vagina 

E ‒ Uterus  (3)

4.1.2 **Function of B (cervix):**

* Provide favourable environment for sperm survival and serve as a reservoir for semen. 
* Transports or facilitates sperm transfer into the uterus. 
* It secrets thick mucus which acts as a barrier during pregnancy

(preventing foreign material or bacteria from entering the uterus) 

* Prevents microbal contermination of the uturus. (Any 1 x 1) (1)

4.1.3 **The functions of glands labelled 1, 2 and 3 from DIAGRAM B:**

* **Gland 1: (Cowper’s gland):**

Secretes a substance that lubricates and cleans urethra / improves mobility of sperms / Contribute to the volume of the ejaculate 

* **Gland 2: (Prostrate):**

Milky alkaline secretion give semen its distinctive smell 

* **Gland 3: (Seminal vesicles):**

Makes about 50% of bull’s ejaculate / Nutrition for sperms /

Responsible for correct pH / Responsible for correct osmotic

pressure of seminal fluid  (3)

4.1.4 **Identification of parts F and G in DIAGRAM B:**

* F ‒ Sigmoid Flexure 
* G ‒ Testicle / Testis  (2)

4.2 **Oestrus cycle in a cow:**

4.2.1 Spermatogenesis  (1)

4.2.2 **Deduction on the type of cell division:**

* Meiosis 
* **Reason** ‒ genetic material is reduced into half (diploid(2n)

changed into haploid (n)/reduction division)  (2)

4.2.3 **The stages of spermatogenesis:**

* **C** –Formation of the spermatids 
* **D** –Formation of sperm cells/spermatozoa (2)

4.3 **Oestrus cycle in a cow:**

* + 1. 21 days (1)

**4.3.2 Devices to detect oestrus in the cow:**

* Pedometer 
* Chin-ball marker 
* Tail-chalking 
* Kamarheatmount detector (Any 2 x 1) (2)
  + 1. **Sequential order of FOUR reproductive hormones produced by a cow:**

* Progesterone 
* Luteotrophic hormone/LTH/prolactin 
* Relaxin 
* Oxytocin (Any 4 x 1) (4)

4.4 **Bar graph:** 4.4.1 **Criteria/rubric/marking guidelines**

0

10

20

30

40

50

60

70

80

90

100

Bull

Ram

Boar

Stallion

Man

Motility (%)

Species

**The bar graph indicating the percentage motility of the**

**ejaculates of different species:**

* Correct heading 
* X-axis – correctly calibrated with label (Species) 
* Y-axis – correctly calibrated with label (Motility) 
* Correct units (%) 
* Bar graph 
* Accuracy  (Any 5 x 1) (5)

4.5 **The breeding technique:**

4.5.1 Embryo transplantation / Embryo transfer / Embryo flushing /

Embryo harvesting  (1)

4.5.2 Donor cow  (1)

4.5.3 **Disadvantages of ET:**

* Expensive 
* Require technical knowledge / Needs veterinarian 
* Genetic viability decreases with the use of only one superior cow 
* Recipient cow may not become pregnant / Abort eggs 
* Diseases can be spread 
* Ethics and animal welfare 
* Synchronisation of recipient and donor can be difficult  (Any 1 x 1) (1)

4.6 **Difficult birth**:

4.6.1 Dystocia  (1)

4.6.2 **Reasons 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 the pelvic area 
* Weak / ineffective labour 
* Cervix failing to dilate 
* Prolonged gestation / pregnancy period 
* Malnutrition 
* Diseases  (Any 2 x 1) (2)

4.6.3 **Parturition process has three distinct stages:**

* Preparatory stage 
* Ejection stage 
* Expulsion of the placenta  (3 x 1) (3)

**[35]**

**QUESTION 4: ANIMAL** **REPRODUCTION**

**4.1 The stages of the oestrus cycle in a cow**

**4.1.1 Indication of oestrus cycle stages:**

(a) **C ** (1)

(b) **B ** (1)

(c) **A ** (1)

* + 1. **Hormones during stage** **C**

1. Oestrogen (1)
2. Luteinising hormone (1)
3. Responsible for the rupturing of the membrane of the

Graafian follicle  (1)

(d) Pro-oestrus  (1)

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)

**4.3 The process of spermatogenesis**

4.3.1 **Deduction on the type of cell division:**

* Meiosis (1)

**Reason** –

* genetic material is reduced into half/diploid(2n) changed into

haploid (n)/reduction division (1)

* + 1. **The stages of spermatogenesis:**

**C –** Formation of the spermatids 

**D –** Formation of sperm cells/spermatozoa  (2)

* + 1. **Part of the testes where spermatogenesis takes place**

* Tubules seminiferous (1)

* + 1. **The organ where the spermatozoa achieve mobility**

* Epididymis (1)

* + 1. **Similarity between spermatogenesis and oogenesis**

* Both occur through meiosis to produce haploid cells 
* Both produce gametes/sex cells  (Any 1) (1)

**4.4** Mating during oestrus

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 produced by a cow**

* Progesterone 
* Luteotrophic hormone/LTH/prolactin 
* Relaxin 

|  |  |  |  |
| --- | --- | --- | --- |
| 4.5 | **Embryo transfer (ET) and superovulation** | |  |
| 4.5.1      4.5.2      4.5.3 | | **Definition of superovulation**  The production of a larger number of ova   at one ovulation   **THREE advantages of embryo transfer (ET)**  More progeny can be produced   Higher profits due to increase in sales   Productive lives of cows are increased   Genetics of the herd is conserved   Superior genes are introduced into the herd  (Any 3)  **Reason for using proven bulls**    • To introduce superior/desirable genes into the herd rapidly and economically  | (2)            (3)    (1)  **[35]** |

* Oxytocin  (Any 4)(4)

**QUESTION 4: ANIMAL REPRODUCTION**

**4.1**

**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)

* + 1. **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)

4.2 S**ynchronisation**

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-arranging the statements in sequential order**

1. C  (1)

1. D  (1)

1. A  (1)

1. E  (1)

1. B  (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 Line graph**

**4.5.1** Line graph showing the percentage of fat and lactose

0

1

2

3

4

5

6

5

10

15

20

25

30

35

40

45

**Fat and lactose (%)**

**Weeks of the year**

**The % of fat and lactose during certain weeks of the year**

Fat

Lactose

**Criteria/rubric/marking guidelines**

* + Correct heading ****
  + X-axis: correct calibrations and labelled (Weeks of the year) 
  + Y-axis: correct calibrations and labelled (Fat and lactose) 
  + Correct unit (%) 
  + Line graph 
  + Accuracy  (6)

* + 1. **Trend shown by the protein content of milk**
* Protein will increase from 3,0 to 4,2% 
* With progression in weeks/from week 5 to 45  (2)

**4.5.3 Constituents of the first milk**

* Immunoglobin/Antibodies 
* Minerals/Calcium(Ca)/Phosphorus(P) 
* Vitamins  (Any 2) **(**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)

**[35]**

**QUESTION 4: ANIMAL REPRODUCTION**

**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 **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)

4.4 **Multiple births**

4.4.1 **Types of twins in representation A and B**

* A **Dizygotic** twin ****
* **B** Monozygotic twin (2)

4.4.2J**ustification**

* **A** – two eggs fertilised to produce two different offspring 
* **B** – one egg cell fertilised to produce two similar offspring (2)

4.4.3 **Process in representation B**

* Cleavage of the same zygote (1)

4.4.4 **Reason for the gender of the twins in representation A**

* Fertilisation of two separate ova(1)

4.4.5 **THREE factors for multiple births**

* Fertility/genetics 
* Environmental factors 
* Breed type 
* Nutrition  (Any 3) (3)

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)

4.6 **Milk ejection**

4.6.1 **TWO stimuli by the milker**

* Washing of udder 
* Massage of the udder 
* Appearance and sound of the milker 
* Milking action  (Any 2) (2)

4.6.2 **Hormone for milk ejection**

* Oxytocin (1)

4.6.3 **Hormone inhibiting milk ejection**

* Adrenalin (1)

4.6.4 **Bacterial disease affecting the udder**

* Mastitis (1)

**[35]**

**QUESTION 4: ANIMAL REPRODUCTION**

4.1

4.1.1 Embryo transfer √ (1)

4.1.2 Prostglandin injection √

Gonadotropin - release hormone √ (2)

4.1.3 A Donor √ (1)

4.1.4 37 °C √ (1)

4.1.5 (a) Their reproductive cycle is extended to produce

more progeny √ (1)

(b) More profit from selling superior animals √ (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)

4.3

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

4.4.1 Exhaustion/Fatigue √ (1)

4.4.2 Malnutrition √ (1)

4.4.3 Lack of experience √ (1)

4.4.4 Temperament √ (1)

4.5

4.5.1

0

20

40

1

5

7

10

15

20

25

**Milk yield (l**

**)**

**Weeks (Time)**

**Milk yield of group 1 and 2 over**

**weeks**

**25**

Group

1

Group

2

Marking graph with the following checklist:

|  |  |  |
| --- | --- | --- |
| Criteria | Yes: 1 mark | No: 0 mark |
| 1 Line graph | 1 | 0 |
| 2 Y-axis labelled | 1 | 0 |
| 3 X-axis labelled | 1 | 0 |
| 4 Points correctly labelled in group 1 |  |  |
| and group 2 | 1 | 0 |
| 5 Correct heading | 1 | 0 |
| 6 Units (and time) | 1 | 0 |

(6)

4.5.2 Milk yield increases drastically in week 7 and drops

from week 15 to week 20. √

**OR**

For both groups milk yield increases from week 1 to week 7

and then it decreases after week 7 until week 25. (1)

4.6

4.6.1 C √ allantois √ (2)

4.6.2 F √ placenta √ (2)

4.6.3 B √ chorion/embryonic sac √ (2)

**35]**

**QUESTION 4: ANIMAL REPRODUCTION**

|  |  |  |  |
| --- | --- | --- | --- |
| 4.1 |  |  |  |
|  | 4.1.1 | **Identification of reproductive organs** |  |
|  |  |  |  |
|  |  | A Seminal vesicles / Vesicular gland √ |  |
|  |  |  |  |
|  |  | B Urethra / Penis / Sigmoid flexure √ |  |
|  |  |  |  |
|  |  |  |  |
|  |  | D Testis/Testicles √ | (3) |
|  |  |  |  |
|  | 4.1.2 | **TWO congenital defects causing sterility in part D.**   * Hypoplasia √ * Cryptochidism √ |  |
|  |  | * Sperm defects √ (Any 2 x 1) | (2) |
|  |  |  |  |
|  | 4.1.3 | **ONE functions of the hormone secreted in part D**   * Production of male gamates / Stimulates sperm   formation/spermatogenesis. √   * Responsible for male masculine characteristics. √ * Promote sexual desire. √ |  |
|  |  | * Promote sexual activity. √ (Any 1 x 1) | (1) |
|  |  |  |  |
| 4.2 | **Cloning** | |  |
|  |  | |  |
|  | 4.2.1 **Differentiation between reproductive and therapeutic cloning.**  **Reproductive cloning** – is a cloning where a new organism is created. √    **Therapeutic cloning** – is a cloning that produces embryonic stem | |  |
|  | cells with the aim of creating tissues to replace injured tissues. √ | | (2) |
|  |  | |  |
|  | 4.2.2 **TWO disadvantages of cloning**   * It is expensive and inefficient. √ * Cloned animals age prematurely. √ * Dystocia problems can rise because clones can be very   large at birth. √   * Cloned animals do not have good immune systems. √ * Clones can produce oversize offspring with enlarged hearts, | |  |
|  | immature lungs and damaged kidneys. √ (Any 2 x 1) | | (2) |

|  |  |  |  |
| --- | --- | --- | --- |
| 4.3 | **Foetus presentation** | |  |
|  |  |  |  |
|  | 4.3.1 | **Letter representing foetus presentation** |  |
|  |  |  |  |
|  |  | (a) B √ | (1) |
|  |  |  |  |
|  |  | (b) A √ | (1) |
|  |  |  |  |
|  | 4.3.2 | **TWO conditions resulting in the illustration marked diagram B.**  Heavy birth weight √  Foetus malformation √  Fle ion of the elbow √  Deviation of the head √ |  |
|  |  | Retention of one or both legs √ (Any 2 x 1) | (2) |
|  |  |  |  |
| 4.4 | **Butterfat content, milk yield and crude fibre of dairy breeds** | |  |
|  |  | |  |
|  | 4.4.1 **Bar graph** | |  |

0

10

20

30

40

50

60

**Quantities of butterfat,milk, crude**

**fibre**

**Types of dairy breeds**

**Bar graph showing butterfat,milk yield and crude**

**fibre of different dairy breeds**

Butterfat

Milk yied

Crude fibre

|  |  |  |
| --- | --- | --- |
|  | **Marking graph with the following checklist** |  |

|  |  |  |
| --- | --- | --- |
| **Criteria** | **Yes: 1 mark** | **No: 0 mark** |
|  Bar graph | 1 | 0 |
|  Y-axis labelled | 1 | 0 |
|  X-axis labelled | 1 | 0 |
|  Points correctly plotted | 1 | 0 |
|  Correct heading | 1 | 0 |
|  Key | 1 | 0 |

(6)

4.4.2 **Dairy breed with the highest milk yield:**

* Holstein √ (1)

4.5 **Equipment and techniques used in animal reproduction.**

4.5.1 **Instrument in DIAGRAM A**

* Artificial vagina √ (1)

4.5.2 **Technique in DIAGRAM B**

* Artificial insemination/AI √ (1)

4.5.3 **Correct time for AI**

When signs of oestrus are observed in the morning,

inseminate in the afternoon √ and vice versa (1)

* + 1. **Type of evaluation illustrated by DIAGRAM C**
* Sperm evaluation √
* Microscopic evaluation √ (Any 1 x 1) (1)

* + 1. **TWO characteristics of semen**

* 80% of sperms should show forward movement √
* Dead sperms should be less than √
* Fewer than 2 of sperms showing signs of deviation √
* No blood should be present √
* No infection √ (Any 2 x 1) (2)

4.6 **Process of ovigenesis**

4.6.1 **Identification of the process**

* Ovigenesis/Oogenesis √ (1)

4.6.2 **Process indicated by letters**

* Mitosis √
* Meiosis II √ (2)

4.6.3 **Letter and name representing haploid cell**

* D √ secondary oocyte √ (2)

|  |  |  |  |
| --- | --- | --- | --- |
| 4.7 | **Technique of embryo transfer** | |  |
|  |  |  |  |
|  | 4.7.1 | **Identification of the technique** |  |
|  |  | Embryo transfer/transplantation/ET √ | (1) |
|  |  |  |  |
|  | 4.7.2 | **TWO advantages of the technique**   * Ten or more progeny from the best cows is produced per year.√ * Profit is made from the increased sale of quality genetics without losing the bloodline. √ * The productive life of older cows is extended. √ * Animals can be bred with improved efficiency of milk or meat production and improved resistance to diseases. √ * Offspring can still be obtained from genetically valuable cows that have become infertile. √ |  |
|  |  | * Genetic material can be transported internationally. √(Any 2 x 1) | (2) |
|  |  |  | **[35]** |

**QUESTION 4: ANIMAL REPRODUCTION**

4.1 **Letter and name of labelled parts**

4.1.1 A √ Testis √ (2)

4.1.2 B √ Epididymis √ (2)

4.1.3 D √ Vas deference √ (2)

4.2 **Congenital defects in a bull**

4.2.1 **TWO congenital defects in part labelled A**

* Cryptorchidism √
* Hypoplasia √ (2)

4.2.2 **Effect of congenital defects**

* Cryptorchidism
* Testis stay to the body cavity √
* No testis in the scrotum where sperms are moving from √
* Hypoplasia
* Testis are underdeveloped √
* Fewer sperm production/low sperm count √ (4)

4.3 **Cloning**

4.3.1 Reproductive cloning √ (1)

4.3.2 **Reason**

So that the cloned lamb is identical to the donor sheep (sheep A. √

**OR**

So that the genetic characteristics of sheep B are not part of the

cloned lamb. √ (2)

4.3.3 An electrical shock √ is used to fuse the two cells at point D. √ (2)

4.3.4 Sheep A √ (1)

4.3.5 **Reason**

Because the donor sheep (A) nucleus (carrier of genetic makeup)

was fused with an egg cell without the nucleus √

therefore only trait of sheep A will be represented in the cloned

lamb √ (2)

4.4 **Process involved in a dairy cow**

4.4.1 Milk let-down process/Mil ejection process √ (1)

4.4.2 **TWO stimuli visible in the illustration**

* Sound of a milling machine √
* Sight of a calf √
* Touch of the udder's s in √ Any 2 x 1) (2)

4.4.3 Oxytocin √ (1)

4.5 **Difficult parturition**

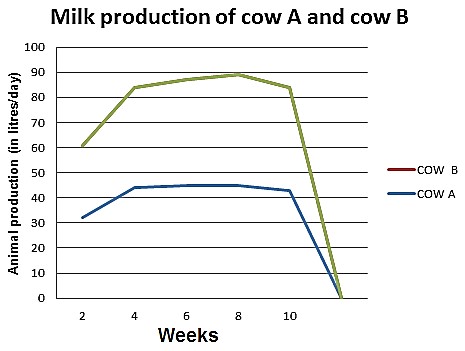
4.5.1 Dystocia **√** (1)

4.5.2 **TWO factors causing dystocia**

* Incorrect presentation, position and posture √
* Large foetus which cannot move through birth canal √
* Torsion of the uterus √
* Malformed foetus √ (Any 2 x 1) 2)

**4.6** Milk production of cow A and cow B

4.6.1 Line graph on milk production of cow A and cow B



**Marking graph with the following checklist**

|  |  |
| --- | --- |
| **Criteria** | **Yes** |
| 1. Line graph | √ |
| 1. X-axis labelled | √ |
| 1. Y-axis labelled | √ |
| 1. Points correctly plotted | √ |
| 1. Correct heading | √ |
| 1. Units indicated on both axes | √ |

Any 5 (5)

4.6.2 **Cow with mastitis**

* Cow A √ (1)

4.6.3 **Reason**

* Sudden drop in milk production at week 12. √ (2)  **[35]**

**MEMORANDUM**

**PRODUCTION FACTORS**

1.1 **MULTIPLE CHOICE QUESTIONS**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1.1.1 | B |  | 1.1.11 | D |  | 1.1.21 | B |  | 1.1.31 | D |  | 1.1.41 | C |
| 1.1.2 | B | 1.1.12 | C | 1.1.22 | C | 1.1.32 | A | 1.1.42 | D |
| 1.1.3 | D | 1.1.13 | B | 1.1.23 | D | 1.1.33 | D | 1.1.43 | B |
| 1.1.4 | B | 1.1.14 | A | 1.1.24 | B | 1.1.34 | C | 1.1.44 | B |
| 1.1.5 | B | 1.1.15 | C | 1.1.25 | A | 1.1.35 | A | 1.1.45 | C |
| 1.1.6 | D | 1.1.16 | B | 1.1.26 | D | 1.1.36 | A | 1.1.46 | A |
| 1.1.7 | B | 1.1.17 | C | 1.1.27 | D | 1.1.37 | B | 1.1.47 | B |
| 1.1.8 | D | 1.1.18 | D | 1.1.28 | A | 1.1.38 | A | 1.1.48 | B |
| 1.1.9 | C | 1.1.19 | C | 1.1.29 | A | 1.1.39 | B | 1.1.49 | C |
| 1.1.10 | C | 1.1.20 | C | 1.1.30 | A | 1.1.40 | A | 1.1.50 | C |

1.2 **MATCHING COLUMNS**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **QUES. 1.2 (Phase 1)** | | |  | **QUES. 1.2 (Phase 2)** | | |
| **1.2.1** | H | **1.2.11** | P | | **1.2.1** | J |
| **1.2.2** | N | **1.2.12** | Q | | **1.2.2** | C |
| **1.2.3** | J | **1.2.13** | S | | **1.2.3** | A |
| **1.2.4** | L | **1.2.14** | T | | **1.2.4** | E |
| **1.2.5** | B | **1.2.15** | Y | | **1.2.5** | I |
| **1.2.6** | E | **1.2.16** | U | | **1.2.6** | G |
| **1.2.7** | C/P | **1.2.17** | W | | **1.2.7** | H |
| **1.2.8** | G/H | **1.2.18** | A | | **1.2.8** | F |
| **1.2.9** | D | **1.2.19** | X | | **1.2.9** | D |
| **1.2.10** | K/B | **1.2.20** | V | | **1.2.10** | B |

1.3 **ONE WORD QUESTION**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1.3.1 | Land |  | 1.3.26 | Petty cash |
| 1.3.2 | Productivity | 1.3.27 | Undercapitalisation |
| 1.3.3 | Farmer / manager | 1.3.28 | Overcapitalisation |
| 1.3.4 | Interest | 1.3.29 | Fixed capital |
| 1.3.5 | Movable capital | 1.3.30 | Labour Productivity |
| 1.3.6 | Product | 1.3.31 | Income statement |
| 1.3.7 | Manager | 1.3.32 | Collateral |
| 1.3.8 | Productivity | 1.3.33 | Seasonal labour |
| 1.3.9 | Credit | 1.3.34 | Decision making |
| 1.3.10 | Motivation | 1.3.35 | Whole farm budget |
| 1.3.11 | Diversification | 1.3.36 | Casual worker |
| 1.3.12 | Grading | 1.3.37 | Insurance |
| 1.3.13 | Insurance | 1.3.38 | Working/ floating |
| 1.3.14 | Casual worker | 1.3.39 | Depreciation |
| 1.3.15 | Short term credit | 1.3.40 | Soil analysis |
| 1.3.16 | Labour relations act | 1.3.41 | Employment Equity Act |
| 1.3.17 | Law of Diminishing returns | 1.3.42 | Appreciation |
| 1.3.18 | GDP | 1.3.43 | Supervision |
| 1.3.19 | Loan | 1.3.44 | Scientific farming |
| 1.3.20 | Grant | 1.3.45 | Competition |
| 1.3.21 | Title deed | 1.3.46 | Legislation |
| 1.3.22 | Enterprise budget | 1.3.47 | Contract |
| 1.3.23 | Budget | 1.3.48 | Liabilities |
| 1.3.24 | Fixed costs | 1.3.49 | Balance sheet |
| 1.3.25 | Interest | 1.3.50 | Restrictedness |

1.4 **REPLACEMENT QUESTION**

|  |  |  |  |
| --- | --- | --- | --- |
| 1.4.1 | Labour | 1.4.26 | Permanent |
| 1.4.2 | Interest | 1.4.27 | Enterprise |
| 1.4.3 | Floating | 1.4.28 | Variable |
| 1.4.4 | Capital | 1.4.29 | Compound |
| 1.4.5 | Assets | 1.4.30 | Cash flow |
| 1.4.6 | Income | 1.4.31 | Labour |
| 1.4.7 | Fixed | 1.4.32 | Seasonal |
| 1.4.8 | Credit | 1.4.33 | Medium |
| 1.4.9 | Floating | 1.4.34 | Assets |
| 1.4.10 | Seasonal | 1.4.35 | Overdraft |
| 1.4.11 | Depreciation | 1.4.36 | Insolvency |
| 1.4.12 | Income | 1.4.37 | Unskilled |
| 1.4.13 | Floating | 1.4.38 | Own Savings |
| 1.4.14 | Overcapitalisation | 1.4.39 | Budget |
| 1.4.15 | Credit | 1.4.40 | Employees/Labourers |
| 1.4.16 | Land | 1.4.41 | Non-arable |
| 1.4.17 | Diminishing | 1.4.42 | Specificity |
| 1.4.18 | Interest | 1.4.43 | Salary / wages |
| 1.4.19 | Permanent | 1.4.44 | Contract |
| 1.4.20 | Floating | 1.4.45 | Movable |
| 1.4.21 | Seasonal | 1.4.46 | Movable |
| 1.4.22 | Private ownership | 1.4.47 | Profit margin |
| 1.4.23 | Movable | 1.4.48 | Short |
| 1.4.24 | Inventory | 1.4.49 | Expenditure |
| 1.4.25 | BEE | 1.4.50 | Overcapitalisation |

**AGRICULTURAL MANAGEMENT AND MARKETING**

1.1 **MULTIPLE CHOICE QUESTIONS**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1.1.1 | C |  | 1.1.11 | A |  | 1.1.21 | B |  | 1.1.31 | C |  | 1.1.41 | D |
| 1.1.2 | D | 1.1.12 | A | 1.1.22 | C | 1.1.32 | A | 1.1.42 | C |
| 1.1.3 | D | 1.1.13 | C | 1.1.23 | A | 1.1.33 | C | 1.1.43 | A |
| 1.1.4 | A | 1.1.14 | D | 1.1.24 | D | 1.1.34 | B | 1.1.44 | B |
| 1.1.5 | A | 1.1.15 | A | 1.1.25 | C | 1.1.35 | C | 1.1.45 | B |
| 1.1.6 | D | 1.1.16 | A | 1.1.26 | C | 1.1.36 | B | 1.1.46 | B |
| 1.1.7 | B | 1.1.17 | B | 1.1.27 | D | 1.1.37 | B | 1.1.47 | D |
| 1.1.8 | C | 1.1.18 | B/D | 1.1.28 | B | 1.1.38 | D | 1.1.48 | C |
| 1.1.9 | C | 1.1.19 | C | 1.1.29 | A | 1.1.39 | B | 1.1.49 | A |
| 1.1.10 | D | 1.1.20 | B | 1.1.30 | B | 1.1.40 | C | 1.1.50 | A |

1.2 **MATCHING COLUMNS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **1.2.1** | E | **1.2.11** | A | **1.2.21** | V |
| **1.2.2** | J | **1.2.12** | B | **1.2.22** | U |
| **1.2.3** | M | **1.2.13** | G | **1.2.23** | T |
| **1.2.4** | I | **1.2.14** | C | **1.2.24** | Q |
| **1.2.5** | L | **1.2.15** | Q |  |  |
| **1.2.6** | N | **1.2.16** | K |  |  |
| **1.2.7** | K | **1.2.17** | O |  |  |
| **1.2.8** | D | **1.2.18** | W |  |  |
| **1.2.9** | H | **1.2.19** | X |  |  |
| **1.2.10** | F | **1.2.20** | R |  |  |

1.3 **ONE WORD QUESTION**

|  |  |  |  |
| --- | --- | --- | --- |
| 1.3.1 | Net-worth | 1.3.26 | Spoilage and rotting |
| 1.3.2 | Promotion | 1.3.27 | Empathy |
| 1.3.3 | Niche | 1.3.28 | Delegation |
| 1.3.4 | External forces | 1.3.29 | Consumer |
| 1.3.5 | Levy | 1.3.30 | Selling |
| 1.3.6 | Market segmentation | 1.3.31 | Floor price |
| 1.3.7 | Marketing approach | 1.3.32 | Farmer/Manager |
| 1.3.8 | Marketing chain | 1.3.33 | Advertisement |
| 1.3.9 | Bartering | 1.3.34 | Marketing |
| 1.3.10 | Loss leading | 1.3.35 | Diversification |
| 1.3.11 | Compound interest | 1.3.36 | Risk |
| 1.3.12 | Overheads | 1.3.37 | Gross price |
| 1.3.13 | Decision making | 1.3.38 | Promotion |
| 1.3.14 | Planning | 1.3.39 | Niche |
| 1.3.15 | Income strategy | 1.3.40 | Business plan |
| 1.3.16 | Processing | 1.3.41 | Grading |
| 1.3.17 | Go-between/Market agents | 1.3.42 | Strategic farm management |
| 1.3.18 | Demand | 1.3.43 | Income statement |
| 1.3.19 | Standardization | 1.3.44 | Co-operative marketing |
| 1.3.20 | Free marketing | 1.3.45 | Market Segmentation |
| 1.3.21 | Diversification | 1.3.46 | Motivation |
| 1.3.22 | Elasticity | 1.3.47 | Segmentation |
| 1.3.23 | Vision and mission | 1.3.48 | Marketing chain |
| 1.3.24 | Hedging | 1.3.49 | Marketing costs |
| 1.3.25 | Evaluation | 1.3.50 | Packaging |

1.4 **REPLACEMENT QUESTION**

|  |  |  |  |
| --- | --- | --- | --- |
| 1.4.1 | Marketing | 1.4.26 | Price elasticity of demand |
| 1.4.2 | Risk | 1.4.27 | Diversification |
| 1.4.3 | Futures contract | 1.4.28 | Entrepreneurship |
| 1.4.4 | Supply | 1.4.29 | Selling |
| 1.4.5 | Processing | 1.4.30 | Mass marketing |
| 1.4.6 | Raw / primary products | 1.4.31 | Business plan |
| 1.4.7 | Overcapitalisation | 1.4.32 | Free |
| 1.4.8 | Elasticity | 1.4.33 | Control |
| 1.4.9 | Supply | 1.4.34 | Supply |
| 1.4.10 | Diversification | 1.4.35 | Perishability |
| 1.4.11 | Cooperative/ pool | 1.4.36 | Logistics |
| 1.4.12 | Demand | 1.4.37 | Physical |
| 1.4.13 | Marketing /chain | 1.4.38 | Planning |
| 1.4.14 | Perishability | 1.4.39 | Internet |
| 1.4.15 | Depreciation | 1.4.40 | Price fixing |
| 1.4.16 | Cooperative | 1.4.41 | Buyer |
| 1.4.17 | Bartering | 1.4.42 | Consumer |
| 1.4.18 | Entrepreneur | 1.4.43 | Marketing chain |
| 1.4.19 | Processing | 1.4.44 | Grading |
| 1.4.20 | Ceiling | 1.4.45 | Auction |
| 1.4.21 | Segmentation | 1.4.46 | Advertisement |
| 1.4.22 | Future’s contract | 1.4.47 | Processing |
| 1.4.23 | 1.4.23 Supply | 1.4.48 | Physical risk |
| 1.4.24 | Manager | 1.4.49 | Buying |
| 1.4.25 | Demand | 1.4.50 | Pool system |

**BASIC AGRICULTURAL GENETICS**

1.1 **MULTIPLE CHOICE QUESTIONS**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1.1.1 | C |  | 1.1.11 | B |  | 1.1.21 | C |  | 1.1.31 | B |  | 1.1.41 | B |
| 1.1.2 | A | 1.1.12 | C | 1.1.22 | B | 1.1.32 | D | 1.1.42 | D |
| 1.1.3 | D | 1.1.13 | C | 1.1.23 | D | 1.1.33 | A | 1.1.43 | A |
| 1.1.4 | A | 1.1.14 | B | 1.1.24 | C | 1.1.34 | D | 1.1.44 | C |
| 1.1.5 | B | 1.1.15 | A | 1.1.25 | B | 1.1.35 | A | 1.1.45 | B |
| 1.1.6 | D | 1.1.16 | D | 1.1.26 | C | 1.1.36 | D | 1.1.46 | B |
| 1.1.7 | B | 1.1.17 | B | 1.1.27 | B | 1.1.37 | A | 1.1.47 | C |
| 1.1.8 | A | 1.1.18 | C | 1.1.28 | D | 1.1.38 | B | 1.1.48 | D |
| 1.1.9 | C | 1.1.19 | B | 1.1.29 | D | 1.1.39 | B | 1.1.49 | B |
| 1.1.10 | C | 1.1.20 | D | 1.1.30 | A | 1.1.40 | C | 1.1.50 | B |

1.2 **MATCHING COLUMNS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **1.2.1** | G | **1.2.11** | S | **1.2.21** | C |
| **1.2.2** | P | **1.2.12** | B | **1.2.22** | V |
| **1.2.3** | F | **1.2.13** | Q | **1.2.23** | R |
| **1.2.4** | E | **1.2.14** | J | **1.2.24** | O |
| **1.2.5** | H | **1.2.15** | U | **1.2.25** | T |
| **1.2.6** | I | **1.2.16** | G | **1.2.26** | Y |
| **1.2.7** | M | **1.2.17** | **L** | **1.2.27** | W |
| **1.2.8** | K | **1.2.18** | N | **1.2.28** | X |
| **1.2.9** | **L** | **1.2.19** | D |  |  |
| **1.2.10** | A | **1.2.20** | Z |  |  |

1.3 **ONE WORD QUESTION**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1.3.1 | GMO |  | 1.3.26 | Prepotency |
| 1.3.2 | Genetic engineering | 1.3.27 | Genetics |
| 1.3.3 | Dihybrid crossing | 1.3.28 | Breeding behavior |
| 1.3.4 | Epistasis | 1.3.29 | Breeding value |
| 1.3.5 | Homozygous | 1.3.30 | DNA |
| 1.3.6 | Dominant | 1.3.31 | Cloning |
| 1.3.7 | Mutation | 1.3.32 | Cross breeding |
| 1.3.8 | Variation | 1.3.33 | Dihybrid cross |
| 1.3.9 | Pedigree | 1.3.34 | Chromatin network |
| 1.3.10 | Dihybrids | 1.3.35 | Genetics |
| 1.3.11 | Genotype | 1.3.36 | Heredity |
| 1.3.12 | Codominance | 1.3.37 | Hereditary |
| 1.3.13 | Biometrics | 1.3.38 | Inbreeding |
| 1.3.14 | Progeny selection | 1.3.39 | Incomplete |
| 1.3.15 | Chromosome | 1.3.40 | Linebreeding |
| 1.3.16 | Variation | 1.3.41 | Law of independent assortment |
| 1.3.17 | Crossing over | 1.3.42 | Law of segregation |
| 1.3.18 | Gene gun | 1.3.43 | Monohybrid cross |
| 1.3.19 | Genetic manipulation | 1.3.44 | Multiple alleles |
| 1.3.20 | Qualitative | 1.3.45 | Mutagens |
| 1.3.21 | Law of Segregation | 1.3.46 | Mutation |
| 1.3.22 | Gene | 1.3.47 | Natural Selection |
| 1.3.23 | Dominant | 1.3.48 | Out crossing |
| 1.3.24 | Dihybrid | 1.3.49 | Polyploidy |
| 1.3.25 | Mutation | 1.3.50 | Prepotency |

1.4 **REPLACEMENT QUESTION**

|  |  |  |  |
| --- | --- | --- | --- |
| 1.4.1 | Mutation | 1.4.26 | Polyploidy |
| 1.4.2 | Prepotency | 1.4.27 | Alkylating |
| 1.4.3 | Hybrid | 1.4.28 | Variation |
| 1.4.4 | Genetics | 1.4.29 | Quantitative |
| 1.4.5 | Variation | 1.4.30 | Dihybridism |
| 1.4.6 | Dominant | 1.4.31 | Phenotype |
| 1.4.7 | Upgrading | 1.4.32 | Chemicals |
| 1.4.8 | Species crossing | 1.4.33 | Radiation |
| 1.4.9 | Selection | 1.4.34 | Inversion |
| 1.4.10 | Monohybridism | 1.4.35 | Natural |
| 1.4.11 | Prepotency | 1.4.36 | Gregor Mendel |
| 1.4.12 | Biometrics | 1.4.37 | Pedigree |
| 1.4.13 | Monohybridism | 1.4.38 | Line breeding |
| 1.4.14 | Hybrid | 1.4.39 | Species crossing |
| 1.4.15 | Atavism | 1.4.40 | Polyploidy |
| 1.4.16 | Dominant | 1.4.41 | Genetic engineering |
| 1.4.17 | Inbreeding | 1.4.42 | Discontinuous |
| 1.4.18 | Gene gun | 1.4.43 | Atavism |
| 1.4.19 | Atavism | 1.4.44 | Complete |
| 1.4.20 | Polygenes | 1.4.45 | Recessive |
| 1.4.21 | Continuous | 1.4.46 | Alleles |
| 1.4.22 | Prepotency | 1.4.47 | Gene |
| 1.4.23 | Crossbreeding | 1.4.48 | Crossbreeding |
| 1.4.24 | Hybrid | 1.4.49 | Translocation |
| 1.4.25 | Cloning | 1.4.50 | Family |

**SECTION B**

**QUESTION 2 : AGRICULTURAL MARKETING AND MANAGEMENT**

2.1

Marking guide:

* Heading (1 mark)
* Labelled y-axis (1 mark)
* Labelled x-axis (1 mark)
* Correct type of graph (1 mark)
* Accuracy (1 mark)
* Correct units ( Rands and bags)

2.1.2 When the price is low, the demand will be high and the supply will be low. At a higher price, the demand will be low and the supply will be high.

Marking guide:

* Heading (1 mark)
* Labelled y-axis (1 mark)
* Labelled x-axis (1 mark)
* Correct type of graph (1 mark)
* Accuracy (1 mark)
* Correct units (1 mark)

2.2.2 1 lamb = 27kg

27X 87= R2349.00

27X87X 65 = R1526.85

2.2.3 Promotion of the product

2.2.4 October – R81 x 27 = R2187

(b) December – 110 x 27 = R2970

2.2.5 The farmer may have run out of stock after December.

2.3

Marking guide:

* Heading (1 mark)
* Labelled y-axis (1 mark)
* Labelled x-axis (1 mark)
* Correct type of graph (1 mark)
* Accuracy (1 mark)
* Correct units

2.3.1 As the price increases, the demand decreases and the supply increases. As the price decreases, the demand and the supply decreases.

2.3.3 Price in week 1 was lower than in week 5. So the lower the price, the higher the demand.

2.4

2.4.1 Processed meat

2.4.2 Because meat has undergone different processing method, its value has increased.

2.4.3 Wheat hasn’t undergone any processing.

2.4.4 (a) Value – most agricultural products are bulky and have a low value, so a lot of space is needed.

(b) Transportation – Agricultural products have to be transported from the point of production to the consumer.

(c) Perishability – most agricultural products lose condition so they need be transported carefully.

2.4.5. - Value adding

- Presence of middlemen

- Transportation cost

2.5.1

2.5.2 Law of demand

2.5.3 Higher the, lower the demand and vice versa.

2.5.4 The higher the income, the higher is the demand. The lower the income, the lower is the demand.

2.6

2.6.1 R20

2.6.2 Out of season, the equilibrium price was R30 and at this price the quantity supplied is 200, and in season the equilibrium price was R20 and the quantity supplied is 400.

2.6.3 In the short term, it’s difficult to produce within a short period of time. Agricultural products need specific period for production.

2.6.4 Value adding

- Can even sell it out of season

- it can be kept for a long time ( long shelf life)

2.7

2.7.1 Product A – its price is fluctuating.

2.7.2 Farm gate

- To wholesale

2.8

2.8.1 Demand curve

2.8.2 R15

2.8.3 It will increase the price

2.9

|  |
| --- |
|  |

2.9.3 For product 1 and 2, the quantities demanded are 15 and 40 respectively.

2.9.4 Depending on the price, supply will either go up and down.

2.9.5

(a) Quality - better the quality, higher is the demand. Lesser the quality, lower is the demand.

(b) Tradition – during festive season demand will be more for a traditional product.

2.10

2.10.1 - A

(b) – B

2.10. 2 Label is missing to represent the shortage, otherwise part below the market equilibrium.

2.10. 3 - R8. 50

2.10.4 – Processing

2.11

2.11. 1 in price fixing, producers will come together and will set price artificially rather than them competing freely.

2.11.2 –

2.11.3 – Advertising

- Sales promotion

- Sponsorship by famous people

- Direct mailing

- Publicity

- Personal selling

2.1. 2 (a) A focused, targetable portion of a market

(b) A marketing strategy that attempts to reach every consumer.

(c) Companies that target more than one segment.

2.1.3 Innovation/ Diversification

2.13.2 Standardisation

2.13.3 Opportunity

2.13.4 Strength

2.13.5 Insurance.

QUESTION 3

**PRODUCTION FACTORS**

**MEMORANDUM: LABOUR AND LAND**

|  |  |  |  |
| --- | --- | --- | --- |
| 3.1 |  |  |  |
|  | 3.1.1 | A = Seasonal labour | (1) |
|  |  | B = Permanent labour | (1) |
|  | 3.1.2 | Photograph A shows the harvesting of chillies by the labour whereas Photograph B |  |
|  |  | shows a machine operator working in the field | (2) |
|  | 3.1.3 | * Less attractive working conditions * Long working hours * Low salaries * Less benefits ANY TWO | (2) |
|  | 3.1.4 | * Better living conditions * Allow labour legislations to function on the farm * Salary increase etc. ANY TWO | (2) |
|  | 3.1.5 | Occupational Safety and Healthy Act | (1) |
| 3.2 |  |  |  |
|  | 3.2.1 | (a) Inspecting water points  Feeding of stud rams  Counting of sheep and keep of records ANY TWO | (2) |
|  |  | (b) Dosing of sheep  Shearing of sheep  Upgrading of dams and watering troughs ANY TWO | (2) |
|  | 3.2.2 | Task 4 | (1) |
|  | 3.2.3 | Task 6 | (1) |
| 3.3 | 3.3.1 | 1. Supply of protective clothing 2. Working hours ;& Wages/salaries 3. Bullet 4 & 5 | (1)  (1)  (1) |
|  | 3.3.2 | Getting salary while you are out of work  Saves money for the labour | (2) |
| 3.4 | 3.4.1 | * Living on farm with the family * Receives bonus * Medical aid scheme * Part of land for his cultivation * Livestock which he/she owns ANY TWO | (2) |
|  | 3.4.2 | Low salaries  Long working hours | (1)  (1) |
|  | 3.4.3 | Increase salaries  Adequate living conditions | (1)  (1) |
| 3.5 | 3.5.1 | Casual labourer = construction of tunnel for vegetable production  Permanent labourer = cultivation of field with tractor  Seasonal labourer = wool shearing | (1)  (1)  (1) |
| 3.6 |  | 1. Short term credit – less than two years’ valuables 2. Medium term credit – less than five years’ valuables 3. Long term credit – 10 years and upwards valuables | (1)  (1)  (1) |
| 3.7 | 3.7.1 | * Low wages * Long working hours * Non-skilled workers |  |
|  | 3.7.2 | (a) Basic Conditions of Employment Act = low wages and long working hours  (b) Skills Development Act = training center to address training and  educational needs of workers. | (1)  (1) |
|  | 3.7.3 | * Appointment of a full-time nurse for primary health care * Social worker to deal with emotional burdens * Establishment of a training center to address educational needs of workers * Improved wages * Sufficient housing ANY THREE | (3) |
| 3.8 | 3.8.1 | Permanent worker = working from 1/02/2011 to retirement, monthly salary by cheque, one week paid leave per annum | (3) |
|  | 3.8.2 | Basic conditions of Employment Act = Item 9,1 & 9,2 & 7 & 8  Occupational Safety and Healthy Act = Item 10 | (1)  (1) |
|  | 3.8.3 | Item 5 – this is a scarce skill that pays a lot of money from the industries | (1) |
|  | 3.8.4 | Loss of productivity due to sickness  Loss of income due to weakness, anxiety, and absenteeism | (2) |
|  |  | LAND AS PRODUCTION FACTOR |  |
| 3.9 | 3.9.1 | (a) Limitedness  (b) Law of diminishing returns  (c) Restrictedness  (d) Production capacity of land varies | (1)  (1)  (1) |
|  | 3.9.2 | Water supply  Consolidation of uneconomic farm units  Application of fertilizer  Efficient mechanization ANY TWO | (2) |
| 3.10 | 3.10.1 | Availability of agricultural land is limited  Most land is occupied by sea, mountains, human settlement etc. | (2) |
|  | 3.10.2 | No land for cultivation and people are depended to buy vegetables and crops to the retailers.  Reduces land for livestock farming which leads to poverty | (2) |
|  | 3.10.3 | Soil analysis  Measuring soil water  Responsible use of pesticides  Sharing land  Sharing machinery  Sharing labour  Sharing buying power | Any  (2) |
| 3.11 | 3.11.1 | A = land is a source of minerals  B = land provides food  C = land provides space  D = land provides space |  |
|  | 3.11.2 | Fertilizer and water supply |  |
| 3.12 | 3.12.1 | The soil is subject to the law of diminishing returns. | (2) |
|  | 3.12.2 | The was a proportional increase between the input(bag of fertilizer) and yield ( (bags of potatoes) until fertilizer input in bags 8 and 10 remain constant. | (2) |
|  |  | **MANAGEMENT AS A PRODUCTION FACTOR** |  |
| 3.13 | 3.13.1 | Communication skills | (1)) |
|  | 3.13.2 | In order to be a good human resource manager, a manager requires good communication skills, be able to listen to workers, have empathy but also have the ability to be strict and fair when it is required. | (2) |
|  | 3.13.3 | Diversification | (1) |
|  | 3.13.4 | Two or more production on the farm reduce dependence on one crop for constant income  With diversification, not all prices or yields can be low or high at the same time. | (2) |
|  | 3.13.5 | Planning, control, decision making, motivation organization and coordination | Any  (2) |
| 3.14 | 3.14.1 | Farmer A has more conceptual skills than others and farmer B has more people skills than the others | (4) |
|  | 3.14.2 | (a) economic planning of farming activities can yield the best results in avoiding the unnecessary expenditure  (b) physical planning of farming activities can yield best results to avoid anything which can pose threats to the environment like pollution ete.  (c)training of farm workers will allow them to attend workshop and meetings in order to develop their skills | (6) |
| 3.15 | 3.15.1 | Farm management can be defined as that part of farming that deals with the organization, operation and risk management of the farm.  Strategic risk management is a process designed to keep both the risks associated with the farm and the costs of running the farm to a minimum. | (4) |
|  | 3.15.2 | Planning, control, motivation, decision making coordination and organization | (5) |
|  | 3.15.3 | They can be applied as the process of designing and maintaining an environment in which individual workers work together to accomplish a specific aim which is successful business. | (1) |
|  | 3.15.4 | **Internal forces:** from within the business, a farmer has control over these forces also known as micro environment such as financial resources and business objectives  **External forces:** from outside the business a farmer has no or limited control over these forces also known as market and micro environments. | (6) |
|  | 3.15.5 | With diversification, not all prices and yields are low or high at the same time is an advantage but sometimes this can be the disadvantage as prices and yield can be low at the same time which can lead to the automatic closure of the farm business. | (4) |
| 3.16 | 3.16.1 | Flexibility: is the ability to change plans over time and as any additional information is received. For example, a farmer can decide about deceasing the number of livestock on the farm when the drought is forecast so that the remaining animals can survive without him or her having to buy extra food.  Hedging: this is a technical procedure that involves the trading of contracts for a future crops by specialize people. This is done worldwide and determine the price of a crop according to the world supply and demand of that crop. | (4) |
|  | 3.16.2 | Planning, decision making, control, motivation and organization | (4) |
| 3.17 | 3.17.1 | Working hours, leaves and meet the minimum wage requirement. | (3) |
|  | 3.17.2 | Workers in farm B.  These employees are subjected to long working hours, less days for leave per year and a lower minimum wage than stipulated by the Law. These employees are prevented to join any farm workers union activities. | (3) |
|  |  |  |  |
|  | 3.17.3 | Basic Conditions of Employment Act, 1997 (Act 75 of 1997) Labour Relations Act | (2) |
|  | 3.17.4 | Seasonal workers – work repetitive tasks , harvesting  Casual workers – work non-repetitive tasks , fencing | (4) |
|  | 3.17.5 | Supervision, daily planning, physical planning, mechanization, Training | (2) |
|  | 3.17.6 | (a) Regulates the relationship between the employer and the employees ( workers).  (b) Addresses the safety of workers in the workplace. | (2)  (2) |
|  | 3.17.7 | (a)External forces – competition,global economic conditions (inflation, recession),political and socio-economic conditions (demographic changes,HIV/AIDS, policy/laws), availability of reliable markets, environmental forces etc.  (b)Internal forces – Sufficient capital, labour efficiency,skills, Management, resources | (3)  (3) |
|  | 3.18 |  |  |
|  | 3.18.1 | |  |  |  | | --- | --- | --- | | Skills | Farm Worker | Farmer | | A | 50% capable | 100% capable | | B | 70% capable | 100% capable | | C | 100% capable | 80% capable | | (6) |
|  | 3.18.2 | Skills |  |
| 3.19 |  |  |  |
|  | 3.19.1 |  |  |
|  |  | 1. Heading with x and y variables (1) 2. X axes correctly calibrated (1) 3. Y axes correctly calibrated (1) 4. Correct type of graph (1) 5. Both units (1) 6. Accuracy (1) | (6) |
|  | 3.19.2 | (a) 32 – 8 = 24 bags of maize  (b) 45 – 48 = -3 bags of maize | (2)  (2) |
|  | 3.19.3 | Law of diminishing returns. Increases per unit of input added are not proportional, until maximum is reached. | (2) |
|  |  |  |  |
| 3.20 |  |  |  |
|  | 3.20.1 | Land is limited | (1) |
|  | 3.20.2 | As population size increse, more land is required for settlement | (2) |
|  | 3.20.3 | Agricultural production will decrease | (1) |
|  | 3.20.4 | * Use of technology (scientific methods), * Use of fertilisers * Water use (irrigation) * Consolidation of uneconomic farm units * Select crops that are suited for the area Any 2 | (2) |
| 3.21 |  |  |  |
|  | 3.21.1 | * Casual labourers |  |
|  | 3.21.2 | * Not employed permanently but temporarily * Work for less than 24 hours a month and do not sign contracts. |  |
|  | 3.21.3 | * Land bank |  |
|  | 3.21.4 | * Use of technology (scientific methods), * Use of fertilisers * Water use (irrigation) * Consolidation of uneconomic farm units * Select crops that are suited for the area Any 2 |  |
| 3.22 |  |  |  |
|  | 3.22.1 | (a) A  (b) C  (c) F  (d) E  (e) E | (5) |
| 3.23 |  |  |  |
|  | 3.23.1 | Photograph A – Fixed capital (milking shed, Land)  Photograph B - Movable capital (equipments,livestock)  Photograph C – Movable capital (tractor | (9) |
| 3.24 |  |  |  |
|  | 3.24.1 | Two bakkies, dairy cows |  |
|  | 3.24.2 |  |  |
|  | 3.24.3 | Grant – is not payed back  Loan – payed back with interest |  |
|  | 3.24.4 | R14 000 X 30 cows  R420 000 |  |
|  | 3.24.5 | |  |  |  | | --- | --- | --- | | Types of capital | Example | Source of capital | | Fixed capital | Milking parlour | NYDA | | Movable capital | Dairy Cows | Local business donation | | Working capital | lucerne |  | |  |
| 3.26 |  |  |  |
|  | 3.26.1 | (a) Overcapitalisation  (b) High interest rates  (c) Subject to high risk |  |
| 3.27 |  |  |  |
|  | 3.27.1 | |  |  | | --- | --- | | Form of credit | Purpose | | Long term credit | To buy fixed capital | | Medium term credit | To but movable capital | | Short term credit | To buy floating capital | |  |
|  | 3.27.2 | * Own Savings * Credit * Production sales |  |
| 3.28 |  |  |  |
|  | 3.28.1 | Income – cattle sales, sheep sales  Variable costs – grain feed  Overhead costs - Telephone bill, marketing levy, electricity | (2)  (2)  (2) |
|  | 3.28.2 | Net income = Total income – total costs  = (R110 500 + R80 900) – (42 350 + 22 500 + 20 000 + 12 500)  = R191 400 –R 97 350  = R94 050 | (3) |

3.29

3.29.1

|  |  |  |  |
| --- | --- | --- | --- |
| **Assets** | **Rands** | **Liabilities** | **Rands** |
| Value of farm | R3500 000 | Tractor loan | R365 000 |
| Value of vehicles | R275 000 | Overdraft | R150 000 |
|  |  | Bond | R4200 000 |
| Cash | R50 000 |  |  |
| Value of buildings | R650 000 |  |  |
| **Total** | **R44750,000** | **Total** | **R4715,000** |
| **Net worth** | **R40035,000** |  |  |
|  |  |  | (9) |

|  |  |  |  |
| --- | --- | --- | --- |
|  | 3.29.2 | The farmer can continue with the business as it came with positive balance. | (2) |
|  | 3.29.3 | Inventory of moveable assets is a document where the medium-term capital goods are recorded e.g. Machinery whereas breeding records is where the performance of each individual animal is recorded e.g. milk production | (2) |
| 3.30 | 3.30.1 | Shows all the expenditure that a farmer expects for a certain period, the farming operation will determine how long this period will be, to determine the viability of the business operation. | (2) |
|  | 3.30.2 | Sales per week = R8000 + R12500 X 4 = 20500 – monthly costs R39000 = R18500 | (3) |
|  | 3.30.3 | The farmer can continue with the business as it has a positive balance | (2) |
| 3.31 | 3.31.1 | Profit = estimated returns – estimated costs  R477500 - R1435646  = - R9581466 | (3) |
|  | 3.31.2 | Could not be recommended as it has a negative balance | (2) |
|  | 3.31.3 | Eco labelling | (1) |
| 3.32 | 3.32.1  3.32.2 | 10 X 4 = R40 000 + R50 000 = R 90 000  R90 000 – R30 000 = R60 000 | (2)  (2) |
|  | 3.32.3 | Business will sink and close  Workers will be retrenched | (2) |
|  | 3.32.4 | Diversification | (1) |
|  | 3.32.5 | Budgeting | (1) |
| 3.33 | 3.33.1 | Assets Liabilities  R50 000 R2 000  R 500 000 R12 000  **R 550 000 R 14 000 Totals** | (4) |
|  | 3.33.2 | Net worth = assets – liabilities  R550 000 – R 14 000  **R536 000** | (3) |
|  | 3.33.3 | Credit is the money borrowed from financial institutions | (2) |
| 3.34 | 3.34.1 | Enterprise budget concentrates on only one business production e.g. maize whereas the whole farm budget concentrates on all the number of businesses taking place on a farm | (2) |
| 3.35 | 3.35.1 | A = Overheads, feeds, seed and seedlings etc.  B = Fixed costs, rent, labour costs etc.  C = Variable costs , electricity and water, marketing costs etc. | (6) |
|  | 3.35.2 | A = Moveable e.g. beef sales, disc plough etc.  B = Working e.g. oil, fertilizer etc. | (4) |
|  | 3.35.3 | Net cash income = total income – total expenditure  R134050 - R203746   * R69696 | (3) |
|  | 3.35.4 | Labour costs, feed, fuel | (3) |
| 3.36 | 3.36.1 | credit | (2) |
|  | 3.36.2 | Sales not yet done still immature | (2) |
|  | 3.36.3 | Profit = income – expense  R54 000 - R433 00 = R107 00 | (3) |
|  | 3.36.4 | Sale of machinery and livestock did not take place | (1) |
|  | 3.36.5 | Cut off non-farm expenses, more sales | (2) |
|  | 3.36.6 | R433,00 | (2) |
| 3.37 | 3.37.1 | Overheads = all ongoing expenses in a business e.g. insurance and licenses etc.  Variable costs = depended on the level of production e.g. electricity and water etc.  Fixed costs = those that do not change e.g. rent etc. | (6) |
|  | 3.37.2 | R179420 | (2) |
|  | 3.37.3 | Net profit = income – expenses  R152580 – 179420  -R26840 |  |
|  | 3.37.4 | For future reference of a farming business  To determine the income and the expenditure of a business | (2) |
| 3.38 | 3.38.1 | Table I = balance sheet and table 2 income statement | (2) |
|  | 3.38.2 | Fixed assets = land value, moveable assets = ready for sale livestock, machinery, working assets = feed, growing crops, positive bank balance | (6) |
|  | 3.38.3 | Net worth farmer A = R510875 – R945000 = R434125  Net worth farmer B = R371666 – R139000 = R232666  Net worth farmer C = R515000 – R356670 = R158330 | (4)  (4)  (4) |
|  | 3.38.4 | Farmer C = unviable  Farmer A = most viable | (2)  (2) |
|  | 3.38.5 | Net income farmer A = R325250 - R230500 = R94750  Net income farmer B = R65000 – R47500 = R17500  Net income farmer C = R254000 – R514500 = R260500 | (4)  (4)  (4) |
|  | 3.38.6 | Fixed costs = (rent, wages on permanent labour) variable costs = (telephone and post) , overheads costs = (seeds and fertilizer} | (6) |
|  | 3.38.7 | Income, expenditure, opening balance, closing balance, total income and total expenditure | (6) |
| 3.39 | 3.39.1 | (a) total income R25000 five carcass, R20000 manure = **R45000**  (b) total expense animal health care , R2240, wages R1200, lick R1360, transport R1000, dehorning R2570, slaughtering fee R3000 = **R11370** | (2)  (2) |
|  | 3.39.2 | Profit/loss = income – expenditure  R 45000 - R11370  R33630 | (3) |

**BASIC GENETICS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Genetic crossing** | | | | |
| 4.1.1 | | **Punnet square – F1** |  | |
|  | | P1 = GG X gg🗸  Purebred green leaves Purebred yellow leaves  Meiosis = G X g 🗸 (gametes)    🗸  G G    F1 g Gg Gg 🗸    g Gg Gg | (4) | |
| 4.1.2 | | **Genotype of F2** |  | |
|  | | 1 : 2 : 1🗸🗸 | (2) | |
| 4.1.3 | | **Dominant characteristic** | (1) | |
|  | | Green leaves🗸 |  | |
| 4.1.4 | | **Calculation : % of yellow leaves in F1** | (1) | |
|  | | Yellow leaves = 0🗸  = X 100🗸  = 0%🗸 | (3) | |
| 4.1.5 | | **N.B : Yellow leaves is a phenotype, therefore 3:1 ratio is used to calculate the number of yellow leaves** |  | |
|  | | 3 + 1 = 4  Therefore:  = X 28🗸  = 7 yellow leaves🗸 | (2) | |
|  | |  |  | |
| **Genetic crossing** | | |  | |
| 4.2.1 | | **Identification of genotype** |  | |
|  | | 1. Parent black cow = Bb/ heterozygous black🗸 2. Parent white bull = bb/ homozygous white🗸 | (1)  (1) | |
| 4.2.2 | | **Phenotype of offspring:** |  | |
|  | | White🗸 | (1) | |
| 4.2.3 | | **Punnet square** |  | |
|  | | ♀ ♂  P = Bb X bb🗸  Heterozygous black cow Homozygous white bull    ♂ b b  ♀ 🗸  B Bb Bb 🗸  b bb bb  F1  = 2 Bb/ heterozygous black : 2bb/homozygous white🗸 | (4) | |
| **Dihybrid crossing** | | |  | |
| 4.3.1 | | **Genotype of individuals:** |  | |
|  | | 1. Number 11 – aaBB/ homozygous horned and black🗸 2. Number 14 – Aabb/ heterozygous polled and homozygous red🗸 3. Number 16 – aabb/ homozygous horned and red🗸 | (1)  (1)  (1) | |
| 4.3.2 | | **Phenotype of the individuals:** |  | |
|  | | 1. Number 6 – Polled and red🗸 2. Number 12 – Horned and black🗸 3. Number 15 - Polled and black🗸 | (1)  (1)  (1) | |
| 4.3.3 | | Parents = AAbb X aabb  Gametes = Ab ab  Ab Ab Ab Ab🗸  🗸ab Aabb Aabb Aabb Aabb    ab Aabb Aabb Aabb Aabb🗸  ab Aabb Aabb Aabb Aabb  ab Aabb Aabb Aabb Aabb  Genotype of offspring: All/16 – Heterozygous Polled and homozygous red🗸 | (4) | |
| 4.3.4 | | **Phenotype of crossing in 4.3.3** |  | |
|  | | All/16 Polled and red offspring🗸 | (1) | |
|  | |  |  | |
| **Crossing of Red and White flowers** | | |  | |
| 4.4.1 | | **Plant with red flowers:** |  | |
|  | | Male plant🗸  Reason:  Red is represented as capital letter R🗸 | (1)  (1) | |
|  | | |  | |
| 4.4.2 | | **Phenotype percentages in F2** |  | |
|  | | 25% Red 🗸  50% Pink🗸  25% White🗸 | (3) | |
| 4.4.3 | | **Type of dominance** |  | |
|  | | Incomplete dominance🗸 | (1) | |
| 4.4.4 | | **Justification:** |  | |
|  | | The appearance of a pink colour indicates that neither red nor white is dominant over the other🗸  **OR**  Pink is an intermediate colour that has not been observed in both parents🗸 | (1) | |
|  | | |  | |
| 4.5.1 | | **Letter for the white colour:** |  | |
|  | | W🗸  **Motivation:**  Because red is not completely dominant over red 🗸 | (1)  (1) | |
| 4.5.2 | | **Genotype of Roan cattle** |  | |
|  | | RW🗸 | (1) | |
| 4.5.3 | | **Crossing:** |  | |
|  | | RR X WW 🗸  Homozygous red Shorthorn bull White Shorthorn cow  ♂ R R🗸  ♀  W🗸 RW RW🗸  W RW RW  Offspring:  Genotype - 4 heterozygous Roan cattle 🗸  Phenotype – 4 Roan cattle🗸 | (6) | |
| **Crossing of parents with different characteristics:** | | |  | |
| 4.6.1 | | **Type of crossing:** |  | |
|  | | Dihybrid crossing🗸 | (1) | |
| 4.6.2 | | **Characteristics received by each offspring from parent 1:** |  | |
|  | | Offspring 1 – Colour/ black colour🗸  Offspring 2 – Shape/ square shape🗸  Offspring 3 – Shape/ square shape🗸 | (1)  (1)  (1) | |
| 4.6.3 | | **Characteristics that are dominant:** |  | |
|  | | Black colour🗸 and Square shape🗸 | (2) | |
| 4.6.4 | | **Percentage of characteristic received from each parent by offspring 2:** |  | |
|  | | 50% shape and 50% colour🗸 | (1) | |
| **Genetic crossing – coat colour** | | |  | |
| 4.7.1 | | **Genotypes of parents:** |  | |
|  | | A – Bb/ heterozygous brown coat🗸  B – Bb/ heterozygous brown coat🗸 | (2) | |
| 4.7.2 | | **Phenotypes of offspring:** |  | |
|  | | 1 - Brown🗸  2 - Brown🗸  3 - Brown🗸 | (1)  (1)  (1) | |
| 4.7.3 | | **Percentage of F1 – heterozygous brown coat colour:** |  | |
|  | | Heterozygous refer to Genotype ratio that is : 1 : 2 : 1 in this case  = 1 + 2 + 1 + 4  = X 100 🗸  = 75%🗸 | (2) | |
| **Genetic crossing of P1 to F1 and F2** | | |  | |
| 4.8.1 | | **Genotypes of (i) and (ii):** |  | |
|  | | 1. Bb/bB🗸 2. bB/Bb | (1)  (1) | |
| 4.8.2 | | **Genotypic ratio as percentage in F1** |  | |
|  | | 100% 🗸Bb/heterozygous blue flowers🗸 | (2) | |
| 4.8.3 | | **Indicate gametes (vi) and (ix):** |  | |
|  | | (vi) B / b🗸  (ix) b / B🗸 | (1)  (1) | |
| 4.8.4 | | **Phenotypic ratio as percentage – F2** |  | |
|  | | 75% blue flowers🗸 : 25% white flowers🗸 | (2) | |
| 4.8.5 | | **Percentage of homozygous white flowers – F2** |  | |
|  | | 25% 🗸 | (1) | |
| 4.8.6 | | **Calculation - % homozygous blue flowers – F2** |  | |
|  | | **Homozygous blue flowers (BB): 1 out of 4**  **Add the ratio:**  = 1(BB) + 2(Bb) + 1(bb) = 4🗸  = X 100 🗸  = 25%🗸 | (3) | |
| 4.8.7 | | **Fraction of heterozygous blue flowers – F1** |  | |
|  | | 🗸 | (1) | |
|  | | |  | |
| 4.9.1 | | **Dominant characteristic in the crossing:** |  | |
|  | | White face🗸  **Reason:**  All the offspring have white face🗸 | (1)  (1) | |
| 4.9.2 | | **Possible percentage of black-faced offspring:** |  | |
|  | | 100%🗸 black-faced offspring🗸 | (2) | |
| 4.9.3 | | **Comparison of chromosome number somatic cells and gametes:** |  | |
|  | | Somatic cells are diploid 🗸while  Gametes are haploid🗸 | (2) | |
|  | | **Crossing Snapdragon plants** |  | |
| 4.10.1 | | **Type of dominance illustrated:** |  | |
|  | | Incomplete dominance🗸 | (1) | |
| 4.10.2 | | **Labels of genotypes:** |  | |
|  | | A - FRR 🗸  B - FRW 🗸  C - FWW 🗸 | (1)  (1)  (1) | |
| 4.10.3 | | **Phenotype ratio – F2** |  | |
|  | | 3🗸 : 1🗸 | (2) | |
| **Crossing horse breeds:** | | |  | |
| 4.11.1 | | **Genotype of horses:** |  | |
|  | | 1. bb🗸 2. Bb🗸 3. bb🗸 4. Bb🗸 | (1)  (1)  (1)  (1) | |
| 4.11.2 | | **Percentage of heterozygous black coat:** |  | |
|  | | 50🗸% 🗸 | (2) | |
|  | | **Crossing Bt maize cultivar:** |  | |
| 4.12.1 | | **Punnet square of cultivars:** |  | |
|  | | Aa X aa  Heterozygous high lysine Homozygous low lysine  Gametes: A a a a  A a🗸    a 🗸 Aa🗸 aa  a Aa **aa**🗸  **Criteria to mark:**  Heterozygous gametes placed correctly - 1 mark  Homozygous gametes placed correctly - 1 mark  50% offspring Aa/ Both Aa visible – 1 mark  50% offspring aa/ Both aa visible – 1 mark | (4) | |
| 4.12.2 | | **Definition of genetic terms:** |  | |
|  | | 1. **Genotype** : the genetic composition🗸 of an organism🗸/ genetic make-up🗸 of an organism🗸 2. **Recessive gene** : gene that is overshadowed/dominated in a crossing by another gene🗸 and becomes less visible/is not expressed in the offspring🗸   **OR** a gene that is masked by the presence of a dominant gene🗸 and can only appear if it is homozygous. 🗸 | (2)  (2) | |
| 4.12.3 | | **Characteristics of genetically modified maize:** |  | |
|  | | * Pest resistance🗸 * Herbicide resistance🗸 * Drought resistance🗸 * Adaptability to environmental conditions🗸 * Disease resistance🗸 * Early maturing to escape harsh conditions🗸 * Longer period of keeping germination ability🗸 (Any 2) | (2) | |
|  | | **Genetic crossing** |  | |
| 4.13.1 | | **Type of genetic crossing** |  | |
|  | | Dihybrid crossing | (1) | |
| 4.13.2 | | **Motivation:** |  | |
|  | | Crossing organisms🗸 that differ in two characteristics🗸/ inheritance🗸 of two genetic characteristics is investigated. 🗸 | (2) | |
| 4.13.3 | | **Mendelian Law depicted:** |  | |
|  | | Independent Assortment of genes: during meiosis / gamete formation, segregated pairs of alleles🗸assort independent of each other. 🗸 | (2) | |
| 4.13.4 | | Calculation of percentage of white hornless |  | |
|  | | **Percentage of hornless offspring:**  X 100🗸  = 25%🗸 | (2) | |
| 4.13.5 | | **Type of inheritance = hornless/white polled offspring in F2** |  | |
|  | | Atavism🗸 | (1) | |
| **Milk production of a Jersey cow** | | |  |
| 4.1.1 | | **Type of inheritance** |  | |
|  | | Polygenic inheritance/ polygenes🗸 | (1) | |
| 4.1.2 | | **Justification:** |  | |
|  | | Milk yield in Jersey cow is controlled by three pairs/many genes🗸  Each dominant gene has an additive value🗸 of 30 litres |  | |
| 4.1.3 | | **Calculate milk yield:** |  | |
|  | | PPQqrR = 200 litres + (30 litres x 4) 🗸 = 320🗸 litres🗸 | (3) | |
|  | |  |  | |
| **Pattern of inheritance – farm animals** | | |  | |
| 4.2.1 | | **Phenomenon** |  | |
|  | | Co- dominance🗸 | (1) | |
| 4.2.2 | | **Reason for the answer:** |  | |
|  | | Both characteristics are observed🗸 in the offspring🗸/ the offspring🗸 has white and brown colour patches🗸 | (2) | |
|  | | **Importance of the concepts:** |  | |
| 4.3.1 | | **Prepotency** – characteristics have greater ability🗸 to be transferred to the offspring/progeny🗸 | (2) | |
| 4.3.2 | | **Atavism** – desired characteristics🗸 that were seen in ancestors re-appear in the offspring🗸 | (2) | |
|  | | **GENETIC MUTATIONS, VARIATIONS AND SELECTION** |  | |
|  | | **Genetic changes – factors that may be beyond control:** |  | |
| 4.1.1 | | **Type of mutation represented in the diagram** |  | |
|  | | Duplication✓ | (1) | |
| 4.1.2 | | **Chromosomal mutation and gene mutation** |  | |
|  | | **Chromosomal mutation** – a change of the structure✓ or number of chromosomes✓  **Gene/point mutation -**: a change✓ in nucleotide sequence of the DNA within a single gene✓ | (2)  (2) | |
| 4.1.3 | | **Mutagenic agents** |  | |
|  | | * Physical mutagents✓ * Chemical mutagents✓ * Biological mutagents✓ (Any 2) | (2) | |
|  | | **Explanation – causes of internal variation:** |  | |
|  | |  |  | |
|  | | **Effects of mutagenic agents:** |  | |
| 4.3.1 | | Gamma and X-rays Damages DNA molecule and causes it to break✓ | (1) | |
| 4.3.2 | | Metals Change the chemical structure of a DNA molecule✓ | (1) | |
| 4.3.3 | | Alkaloids They prevent chromosome segregation✓ | (1) | |
| 4.3.4 | | Viruses They insert their own DNA✓ | (1) | |
|  | |  |  | |
| 4.4.1 | | **Concepts = statements /description** |  | |
|  | | 1. Polyploidy✓ 2. Aneuploidy✓ 3. Inversion✓ | (1)  (1)  (1) | |
| 4.4.2 | | **Beneficial characteristics of mutants:** |  | |
|  | | Improved yield and quality✓  Resistance to pests and diseases✓ | (2) | |
|  | | **Various methods of mutation** |  | |
| 4.5.1 | | Picture A – duplication✓  Picture B – deletion✓  Picture C - inversion✓ | (3) | |
| 4.5.2 | | **Identify the type of mutagenic agent in the following conditions:** |  | |
|  | | 1. Physical agent🗸 2. Biological agent🗸 | (2) | |
|  | | **MUTATION, VARIATION AND SELECTION** |  | |
|  | | **Scenario on variation** |  | |
| 4.6.1 | | **Explain importance of variation in breeding** |  | |
|  | | Variation is a foundation of desirable characteristics ✓for farmers to choose for further breeding✓ to improve crop varieties✓ and livestock breeds over time. ✓ (Any 2) | (2) | |
| 4.6.2 | | **Genetic causes of variation** |  | |
|  | | * Meiosis✓ * Fertilisation✓ * Mutation ✓ (Any 2) | (2) | |
| 4.6.3 | | **Distinguish between Continuous and Discontinuous variation** |  | |
|  | | **Continuous variation** – a complete range of variation of a characteristic from one extreme to the other✓  Discontinuous variation – variation in which characteristics have clear-cut/distinct forms with no intermediate forms in between✓ | (1)  (1) | |
|  | | **Variation Graphs** |  | |
| 4.7.1 | | **Type of variations:** |  | |
|  | | A – Discontinuous variation  B – Continuous variation | (1)  (1) | |
| 4.7.2 | | **Justification:** |  | |
|  | | **A** – the characteristic displays clear cut forms from one extreme to the other. ✓  **B** – the characteristic displays a range of variety from one extreme to the other✓ | (2) | |
| 4.7.3 | | **TWO external causes of variation** |  | |
|  | | * Diseases ✓ * Pests and parasites✓ * Climate/rainfall/temperature✓ * Sunlight/light intensity ✓ * Feeding/food/fertilization/fertilizers✓ * Topography ✓ (Any 2) | (2) | |
| 4.7.4 | | **Important roles of genetic variation in a breeding programme:** |  | |
|  | |  |  | |
|  | | **Graph on variation** |  | |
| 4.8.1 | | **Identify breed – lowest fat content** |  | |
|  | | Holstein🗸 | (1) | |
| 4.8.2 | | **Breed with the smallest variation for fat content.** |  | |
|  | | Holstein/ Aryshire🗸 | (1) | |
| 4.8.3 | | **Breed that would be recommended in a cross-breeding programme** |  | |
|  | | Jersey🗸 | (1) | |
| 4.8.4 | | **Reason for the bell-shaped variation curve** |  | |
|  | | Difference in performance between individuals in the population🗸/ variation between individuals in the population for fat production in milk🗸 | (1) | |
|  | | **Scenario on Traditional selection:** |  | |
| 4.9.1 | | **Definition of the process** |  | |
|  | | * Process of choosing/identifying specific individuals🗸 * For their desired characteristics/traits🗸 * To be used in the production of quality offspring🗸 (Any 2) | (2) | |
| 4.9.2 | | **Method of selection mentioned in the passage** |  | |
|  | | Mass selection🗸 | (1) | |
| 4.9.3 | | **THREE animal production characteristics considered for selection:** |  | |
|  | | * Growth🗸 * Health * Fertility🗸 | (3) | |
| 4.9.4 | | **Aspects to improve phenotype of animals:** |  | |
|  | | 1. Best bulls for growth/health/fertility were shared🗸 2. Utilising the best available pastures/keeping them away from wet/muddy areas🗸 | (1)  (1) | |
|  | |  |  | |
| **ESTIMATED BREEDING VALUES (EBV) & HERITABILITY** | | |  | |
| 4.1.1 | | **Breeding values** |  | |
|  | | EBV = Weaning weight – Average weaning weight x heritability 🗸  EBV = (350 – 310) x 🗸    = 40 x 0,6 = 24kg 🗸 | (3) | |
| **Heritability calculation:** | | |  | |
| 4.2.1 | | **Breeding values – slaughter weight** |  | |
|  | | EBV = Parent slaughter weight – Average slaughter weight flock X Heritability🗸  = 47.3kg – 52.5 kg X 85%🗸  = -5.2kg X 85%    = -4.42kg🗸 | (3) | |
| 4.2.2 | | **Implication of the value in QUESTION 4.2.1.** |  | |
|  | | The sheep will produce offspring🗸 with a slaughter weight that will  be -4.42kg lighter. 🗸 | (2) | |
| 4.2.3 | | **The following heritable characteristics mean during the selection process.** |  | |
|  | | (a) **Birth weight** = less heritability🗸, therefore the characteristic is  controlled by the environment🗸/  **OR** The farmer need to develop a feeding program  🗸because birth weight has less heritability/ birth weight  has heritability of less than 50% 🗸  (b) **Meat tenderness** – the characteristic has high heritability/ has  heritability that is more than 50%🗸, therefore it is  controlled by genes🗸 | (2)  (2) | |
| 4.2.4 | | **Definition: EBV:** |  | |
|  | | EBV – estimate of how better or worse than average🗸 the offspring of an individual will be for a particular characteristic🗸 | (2) | |
| 4.2.5 | | **Selection methods used by animal breeders:** |  | |
|  | | * Mass selection🗸 * Pedigree selection🗸 * Family selection🗸 * Progeny selection🗸 | (4) | |
|  | |  |  | |
|  | | **Scenario on Ayrshire breeds** |  | |
| 4.3.1 | | **Breeding type** |  | |
|  | | Upgrading🗸 | (1) | |
| 4.3.2 | | **Justification:** |  | |
|  | | Farmer is using Holstein semen🗸 to improve production potential of inferior cows/ Ayrshire breeds🗸 | (2) | |
|  | |  |  | |
| **Values of heredity in sheep:** | | |  | |
| 4.4.1 | | **Determination of the EBV for birth** |  | |
|  | | EBV = (Lamb weight – average weight) x % heritability 🗸    = (3kg – 1,8kg) x 60% 🗸  = 0,72 kg🗸 | (3) | |
| 4.4.2 | | **Implication of the calculated value** |  | |
|  | | * The offspring will be 0,72kg heavier🗸 than the average flock 🗸 * The average flock will be 0,72kg smaller 🗸 than the offspring of the lamb 🗸 * An increase in birth weight 🗸 above the average of the flock by 0,72kg 🗸 (Any 1) | (2) | |
| 4.4.3 | | **Heritability of the fleece weight** |  | |
|  | | 50%🗸 | (1) | |
| 4.4.4 | | **TWO reasons the post-weaning weight gain cannot be recommended for breeding purposes** |  | |
|  | | * Environment has a huge influence in the outcome of the characteristics 🗸 * Low heritability/33% heritable 🗸 | (2) | |
| 4.4.5 | | **Importance of using EBV** |  | |
|  | | It indicates the heritability of a particular characteristic 🗸 to predict the success of a breeding programme 🗸 | (2) | |
|  | | **Biometrics and Genetics in animal improvement:** |  | |
| 4.5.1 | | **Data on heritable characteristics of goats** |  | |
|  | | 1. **Calculate the EBV of ram and ewe.** |  | |
|  | | **Ram:**  PWW of Ram – Average PWW of flock X heritability  = 19.2kg – 17.5kg X 57%🗸  = + 0.97kg🗸  **Ewe:**  PWW of Ewe – Average PWW of flock X heritability  = 21.4kg – 17.5kg X 57%🗸  = + 2.22kg🗸 | (4) | |
|  | | 1. **Expected genetic gain of the animals:** |  | |
|  | | EBV of Ram + EBV of Ewe ÷ 2  = 0.97 kg + 2.22kg ÷ 2🗸  = + 1.59kg/ +1.6kg 🗸 | (2) | |
|  | | 1. **whether the animals can be selected for further**   **breeding.** |  | |
|  | | Animals can be selected🗸 | (1) | |
|  | | 1. **Justification** |  | |
|  | | The animals will produce offspring with +1.6kg🗸 heavier in PWW 🗸 | (2) | |
|  | | 1. **Characteristic that the farmer cannot select for breeding purposes** |  | |
|  | | Fleece weight🗸 | (1) | |
|  | | 1. **Reason for not selecting the characteristic** |  | |
|  | | Fleece weight has a low heritability percentage of 26%/ is less than 50%🗸, therefore it is controlled by the environment/ is not controlled by genes/ can be affected by the environment negatively🗸 | (2) | |
|  | | **BREEDING SYSTEMS** |  | |
|  | | **Scenario on weaners** |  | |
| 4.1.1 | | **Identification of the animal breeding system applied by Farmer B** |  | |
|  | | Crossbreeding🗸  Reason • Crossing of two different breeds🗸 | (1)  (1) | |
| 4.1.2 | | **TWO advantages of out crossing** |  | |
|  | | The least likely system to produce any problems🗸  Offspring will carry the traits characteristics of both parents🗸  Improve genetic diversity/new blood line is introduced🗸 (Any 2) | (2) | |
| 4.1.3 | | **TWO reasons why the old and non-fertile cows are sold** |  | |
|  | | Reached the end of their production cycle/not productive🗸  Efficiency by saving on nutrition🗸  Improve the fertility of the herd 🗸  More economical for the farmer 🗸 (Any 2) | (2) | |
| 4.1.4 | | **Breeding system used by Farmer B with his own bulls** |  | |
|  | | Line/in breeding 🗸 | (1) | |
|  | | **Animal breeding – Hereford and Sussex breeds** |  | |
| 4.2.1 | | **Identification of the breeding method** |  | |
|  | | Crossbreeding 🗸 | (1) | |
| 4.2.2 | | **THREE benefits to farmer B** |  | |
|  | | * New breeds developed🗸 * Animals will adapt better in varying conditions/better vitality🗸 * Animals will be more resistant to diseases🗸 * High mass gain in relation to food intake🗸 * Leads to heterosis/hybrid vigour 🗸 (Any 3) | (3) | |
| 4.2.3 | | **A possible advantage of this breeding method to Farmer A** |  | |
|  | | * Making money by selling bulls/sells to farmer B🗸 | (1) | |
|  | | **Data – pre-weaning growth rates on cattle crosses** |  | |
| 4.3.1 | | **Type of breeding system** |  | |
|  | | Cross breeding✓ | (1) | |
| 4.3.2 | | **Parents that produced calves with highest average daily gain** |  | |
|  | | **Hereford bulls and Brahman cows** |  | |
| 4.3.3 | | **TWO reasons for better performance of these** |  | |
|  | | * Offspring have hybrid vigour/heterosis ✓ * Are better adapted to poor veld conditions/more hardy ✓ * Have a better feed conversion rate ✓ (Any 2) |  | |
| 4.3.4 | | **Bar Graph** |  | |
|  | | **Criteria/rubric/marking guidelines**   * Correct heading ✓ * X axis - correctly calibrated and labelled (number crossing) ✓ * Y-axis – correctly calibrated and labelled (ADG) ✓ * Correct units (g/day) ✓ * Accuracy ✓ * Bar graph ✓ | (6) | |
|  | | **Mating with pure-bred Bonsmara bulls** |  | |
| 4.4.1 | | **Type of breeding system** |  | |
|  | | Upgrading✓ | (1) | |
| 4.4.2 | | **Two disadvantages of upgrading:** |  | |
|  | | * Time consuming✓ * Bulls must always be bought from outside to reduce inbreeding/ it is expensive✓ * The commercial value of the first few generation is low✓ * The offspring can never be bred 100% pure✓ (Any 2) | (2) | |
| 4.4.3 | | **Determination of the number of crossings:** |  | |
|  | | 5 crosses✓ | (1) | |
| 4.4.4 | | **Calculation of the percentage characteristic:** |  | |
|  | | **Cow: ½ x 75% = 37,5%**✓  **Bull: ½ x 100% = 50%**✓  **37,5% + 50%** ✓ **= 87,5%** ✓  **OR**  **½** ✓ **x (75%** ✓**+ 100%**✓**) = 87,5%** ✓  **OR**  ✓ **= 87,5%**✓ | (4) | |
|  | | **Breeding systems:** |  | |
| 4.5.1 | | **Identification of breeding system:** |  | |
|  | | A - Species crossing✓  B – Line breeding | (1) | |
| 4.5.2 | | **Disadvantage of breeding system in A** |  | |
|  | | Offspring becomes sterile/ cannot reproduce further✓ | (1) | |
|  | | **The different breeding methods** |  | |
| 4.6.1 | | Picture A – cross breeding🗸  Picture B – cross species/species crossing🗸 | (1)  (1) | |
| 4.6.2 | | **Justification of the answer in 4.6.1** |  | |
|  | | Picture A is the crossing between the two different dairy breeds🗸  Picture B is a crossing between two different species🗸 | (1)  (1) | |
| 4.6.3 | | **Tabulate advantages of the breeding methods:** |  | |
|  | | |  |  | | --- | --- | | **Advantages of cross breeding** | **Advantanges of species crossing** | | Progeny more resistant to diseases🗸 | Produce mules🗸 | | Increased vitality🗸 | Can work better than horses🗸 | | Rapid development compared to parents🗸 | Useful draught animals🗸 | | Better adaptation🗸 | Less susceptible to disease🗸 | | Development of new breeds🗸 | Faster than heavy draught horses🗸 | | (Any 2 of each) | | | (4) | |
|  | | **Picture - Breeding system of goats** |  | |
| 4.7.1 | | **Type of breeding method** |  | |
|  | | Upgrading✓ | (1) | |
| 4.7.1 | | **Advantages/benefits of the breeding system - upgrading:** |  | |
|  | | * New breed is gradually imported into the herd/fewer adaptation problems✓ * Economical way to raise the stock to a pedigree level✓ * Initial rapid results (50% improvement in first generation) ✓ * Deformities and unwanted characteristics occur less frequent✓ * Expert knowledge not needed✓ * Creates a more uniform herd✓ (Any 3) | (3) | |
| 4.7.3 | | **Selection methods used by animal breeders** |  | |
|  | | * Family selection✓ * Mass selection * Progeny selection✓ * Pedigree selection✓ * Natural selection✓ * Breeding values✓ | (4) | |
| 4.7.4 | | **Disadvantage of upgrading:** |  | |
|  | | Improvement is relatively slow after the fourth generation✓✓ | (2) | |
|  | | **Scenario** |  | |
| 4.8.1 | | **Selection and Heritability** |  | |
|  | | **Selection** – process of choosing desirable characteristics✓ from individuals for further breeding✓  **Heritability** – the degree to which characteristics✓ are controlled by genes✓ | (2)  (2) | |
| 4.8.2 | | **Advantages of species crossing:** |  | |
|  | | * Hardy/draught animals are produced✓ * Mules have no digestive problems compared to horses✓ * Mules do not tire easily✓ (Any 2) | (2) | |
| 4.8.3 | | **State TWO related breeding systems not mentioned in the scenario.** |  | |
|  | | * Line breeding✓ * Inbreeding✓ | (2) | |
|  | | **GENETIC MODIFICATION** |  | |
|  | | **Plant Improvement:** |  | |
| 4.1.1 | | **Identify the process** |  | |
|  | | Genetic modification/ Genetic engineering/ Genetic manipulation/GM🗸 | (1) | |
| 4.1.2 | | **Main risks of the process** |  | |
|  | | * Food safety🗸 * Environmental issues🗸 * Socio-economic effects 🗸 (Any 2) | (3) | |
| 4.1.3 | | **Name the organisms:** |  | |
|  | | C - Transgenic/GMO🗸 | (1) | |
| 4.1.4 | | **Characteristics of genetically modified crop** |  | |
|  | | * Herbicide resistance🗸 * Insect resistance🗸 * Resistance to harsh environmental conditions🗸 * Improved nutritional value/starch/vitamins🗸 * Modified/improved quality🗸 (Any 3) | (3) | |
|  | |  |  | |
|  | | **GM of Lettuce** |  | |
| 4.2.1 | | **Difference in yield of GM lettuce and non-GM lettuce** |  | |
|  | | GM lettuce produce better under different conditions 🗸 than non- GM plants under the same conditions 🗸 | (2) | |
| 4.2.2 | | **Advantage of GM lettuce in both conditions** |  | |
|  | | Higher yield/ produce better🗸 | (1) | |
| 4.2.3 | | **Benefits of genetic engineering over traditional methods** |  | |
|  | | * Precise/desired genes are transferred🗸 * Not limited to crossing of the same species 🗸 * More convenient 🗸 * Faster/requires only one generation to complete🗸 * More resistant to pests/drought/diseases/herbicides🗸 * Higher yields🗸 (Any 3) | (3) | |
| 4.2.4 | | **Environmental risks of genetically modified plants** |  | |
|  | | * Creation of herbicide resistant ‘superweeds’/harmful pesticide resistant plants🗸 * Indiscriminate use of herbicides pollute the environment 🗸 * Beneficial insects can be killed 🗸 (Any 2) | (2) | |
|  | |  |  | |
|  | | **Two maize farmers in a typical maize growing area** |  | |
| 4.3.1 | | **The year when farmer B changed to GM crops** |  | |
|  | | 2012🗸 | (1) | |
| 4.3.2 | | **Advantage that farmer B gain from using GM maize seed based on the data** |  | |
|  | | Increased yield/production🗸/  Production increase from 10,6 - 12 started in 2012🗸/  Production improved progressively more from 2012 - 2015 | (1) | |
| 4.3.3 | | **Characteristics of GM maize cultivars that could be responsible for the advantage that Farmer B gained** |  | |
|  | | * Resistance to diseases🗸 * Resistance to insects and pests🗸 * Resistance to drought/ harsh environmental conditions🗸/Crops have lower water requirements🗸 * Better adaptation to the region🗸 (Any 3) | (3) | |
| 4.3.4 | | **Main reason for general resistance against the use of GM cultivars.** |  | |
|  | | * Threat to human health/ composed of toxic chemicals that can cause allergies/illness * Environmental risks🗸 (Any 1) | (1) | |
|  | |  |  | |
|  | | **Cartoon on the use of GM crops** |  | |
| 4.4.1 | | **Effect of GM crops in the cartoon:** |  | |
|  | | GM crops pollinate weeds🗸 resulting into superweeds🗸 | (2) | |
| 4.4.2 | | - Genes for herbicide resistance could be spread from GM crops to weeds  making them resistant to herbicides. 🗸  - Superweeds compete with production crops for water and sunlight🗸  - Increased input costs to eradicate superweeds/ difficult to eradicate🗸  - Reduced agricultural crop yield🗸  - Use of excessive chemicals promote global warming🗸 (Any 2) | (2) | |
|  | | **Genetic modification techniques:** |  | |
| 4.5.1 | | **Genetic modification technique:** |  | |
|  | | Agrobacterium tumefaciens/bacterial carries🗸 | (1) | |
| 4.5.2 | | **Steps during Agrobacterium tumefaciens:** |  | |
|  | | A - Desired gene inserted into plasmid🗸  B - Plasmid inserted into plant cell/disabled to prevent them from causing  disease in the recipient plant🗸  C - Plasmid inserts desired gene into plant DNA/Used as a carrier to  transfer a piece of its DNA into the chromosome of a plant🗸  D - Tissue culture is then formed/Plant pieces are then grown into whole🗸 | (4) | |
| 4.5.3 | | **Genetic modification techniques:** |  | |
|  | | * Micro-injection🗸 * Gene gun🗸 * Electroporation 🗸 * Biolistics 🗸 * Gene silencing🗸 * Gene splicing🗸 * Lipofection 🗸 * Viral carries🗸 * Calcium phosphate precipitation🗸 (Any 3) | (3) | |
|  | | **GMO – threat to food safety for human consumption** |  | |
|  | | * May be a possibility of cancer 🗸 * Loss of effective immune system🗸 * Lead to food allergies🗸 * Subjected to toxicological tests that can affect humans negatively🗸 | (4) | |
|  | | **Benefits of GMOs** |  | |
|  | | * Use of less pesticides that are toxic to soil🗸 * Allow no tillage farming system🗸 * Food with better flavour🗸 * Reduce input costs of production🗸 * Long shelf-life 🗸 * Resistance to insects, herbicides and diseases🗸 * Tolerance to harsh environmental conditions🗸 * Short ripening period🗸 * Require less water for production/tolerance to drought🗸 * Increase in yield🗸 (Any 4) | (4) | |
|  | | **Graph on Genetic modification** |  | |
| 4.8.1 | | **Definition : GMO** |  | |
|  | | The technique of manipulating/altering/changing characteristics of an organism🗸 by inserting genes from another organism into its DNA. 🗸 | (2) | |
| 4.8.2 | | **Present the information in the graph in the form of a table** |  | |
|  | |  |  | | --- | --- | | **Increase** **in the global area of biotechnological crops 1996 – 2003** | | |  | | | **Years** | **Increase in global area** | | 1996 | 4,2 | | 1997 | 27,5 | | 1998 | 69,5 | | 1999 | 99,4 | | 2000 | 100.2 | | 2001 | 130 | | 2002 | 145 | | 2003 | 167,2 |   **1 mark = heading**  **1 mark correct table of years**  **1 mark = correct table of global area data**  **1 mark = labelling table topics/items** | | (4) | |
| 4.8.3 | | **Deduce the trend shown in the graph over years:** |  | |
|  | | The use of biotechnology/genetic engineering increases🗸 every year🗸/ The use of biotechnology/genetic engineering increases🗸 with time🗸 | (2) | |