



AGRICULTURAL SCIENCES

GRADE 12

WINTER CLASSES

Topics: Agricultural Genetics and Marketing

TEACHER AND LEARNER CONTENT MANUAL



AGRICULTURAL SCIENCES PROGRAMME FOR WINTER CLASSES

PAPER	TOPICS
TOPIC 1: BASIC AGRICULTURAL GENETICS	Genetics concepts (2 hours)
	Patterns of inheritance (2 hours)
	Variation and mutation (2 hours)Marketing systems(3 hours)
	Breeding and selection (2 hours)
	Genetic modification (1 hour)
TOTAL 9 hours	
TOPIC 2 : AGRICULTURAL MARKETING	Agricultural marketing, Price determination (3 hours)
	Elasticity of demand and supply. Market equilibrium (3 hours)
	Agricultural Marketing systems (3hours)
TOTAL 9 hours	

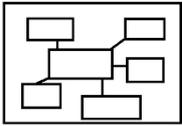
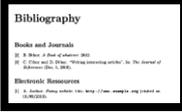
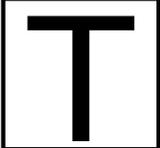
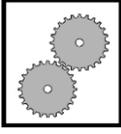


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ICON DESCRIPTION

 MIND MAP	 EXAMINATION GUIDELINE	 CONTENTS	 ACTIVITIES
 BIBLIOGRAPHY	 TERMINOLOGY	 WORKED EXAMPLES	 STEPS

EXAMINATION GUIDELINES: BASIC AGRICULTURAL GENETICS

The following aspects of the content will be assessed as indicated: (Remember this is just to indicate key areas of focus, but it should be read in conjunction with ATP in the CAPS document.

Questions covering most of the main content areas.

Background knowledge from Grade 10 content on the biological concepts (plant and animal cells and cell division [mitosis and meiosis]) is key in this question.

Learners will be assessed on the implication of the principles of breeding:

- Key genetic concepts/terminology genetics, heredity, genes, chromosomes and alleles (homozygous and heterozygous).
- Distinction between the following: genotype and phenotype, dominant and recessive genes.
- Ability to do a monohybrid cross and how it relates to Mendel's law of segregation.
- Ability to do a dihybrid cross and how it relates to Mendel's law of independent assortment.
- Use the Punnett square, schematic diagrams and pedigree diagrams to solve genetic problems.

f) Punnett square will be assessed as follows:

Punnett square

	b	B ✓
B	Bb	BB
b ✓	bb	Bb ✓

MARKING CRITERIA:

Populated Punnett square ✓

Correct gametes for Parent 1 ✓

Correct gametes for Parent 2 ✓

Correct offspring ✓

g) Distinguish between qualitative and quantitative characteristics as it relates to variation.

h) Application of the patterns of inheritance that lead to different phenotypes of Inheritance in agriculture environment.

i) Heritability as:

- Concept
- Implication in breeding

j) Biometrics

- Understanding of statistical values to generate breeding values.
- Interpretation of the knowledge of breeding values for future breeding.

k) Breeding systems learners will be assessed based on:

- Indication of the terminology (inbreeding, line breeding, crossbreeding, upgrading, species crossing, outcrossing).
- Interpretation of flow diagrams on different breeding systems, patterns of inheritance.
- Interpretation of information on multiple alleles and the effect of polygenes in enhancing a heritable characteristic.

- Identification of the breeding systems based on the examples given in the statements.
- Stating advantages or disadvantages of the products of that breeding system.

l) Importance of variation and selection for breeding in agriculture

- Identification of external (environmental) and internal (genetic) causes of variation in a scenario or statements.
- The types of mutagenic agents and their effects.
- Changes in chromosome structure.
- Natural versus artificial selection

m) Understanding of the concept genetic modification/engineering

- Its application to agriculture (plants and animals), aims, techniques, risks and benefits Content areas are indicated in the annual teaching plan of the CAPS document for Agricultural Sciences

TERMINOLOGY

Term	Description
Genetics	The study of genes and heredity
Gene	is a basic unit of heredity that carried in the DNA from parents to offspring
Chromosome	Is a threadlike structure of nucleic carrying genetic information in the form of genes/ A chromosome is a long DNA molecule with part or all the genetic material of an organism
DNA	(Deoxyribonucleic acid) -a chemical substance from which genes are made
Heredity	passing of genetic information and its trait from parent to offspring
Trait	is a specific characteristic of an individual (can be qualitative-eye colour) or (quantitative-height)

Haploid	the presence of a single set of chromosomes in an organism's cells
Diploid	the presence of two complete sets of chromosomes in an organism's cells, with each parent contributing a chromosome to each pair
Monohybrid crossing	is a genetic cross between parents that have different alleles for one particular gene
Dihybrid crossing	is a cross between two organisms with observed traits that are controlled by two distinct genes.
Allele	an alternative form of a gene.
Recessive	is an Allele that is masked by a dominant allele
Dominant	an allele that masks or overshadows the characteristics of a recessive allele
Co-Dominance	pattern of inheritance where both alleles are equally dominant and both are expressed in the heterozygous
Complete dominance	Dominance where the dominant allele completely masks the effect of the recessive allele in heterozygous condition
Incomplete dominance	occurs when there is a relationship between the two versions of a gene, and neither is dominant over the other
Homologous pair	are two pieces of DNA within a diploid organism which carry the same genes, one from each parent source
Homogeneous	having the same allele for a particular gene on both homologous chromosomes
Heterogeneous	having inherited different alleles for a particular gene on each homologous chromosomes from each parent
Genotype	is a set of genes in DNA responsible for unique traits or characteristics (TT or tt)
Phenotype	is the physical appearance or characteristics of an organism (colour, height or shape)
Hereditary	the ability of parents to pass its characteristics to offspring
Heredity	the transfer of characteristics from parents to offspring

CHAPTER 1: GENETIC CONCEPTS

DIFFERENCE BETWEEN:

1.1 Genetics and Gene

Genetics is the study of genes and heredity is how genes are passed from parents to offspring through the DNA. offspring inherit characteristics such as height, eye colour

Gene

- A unit of heredity that controls the development of one trait
- Made of DNA

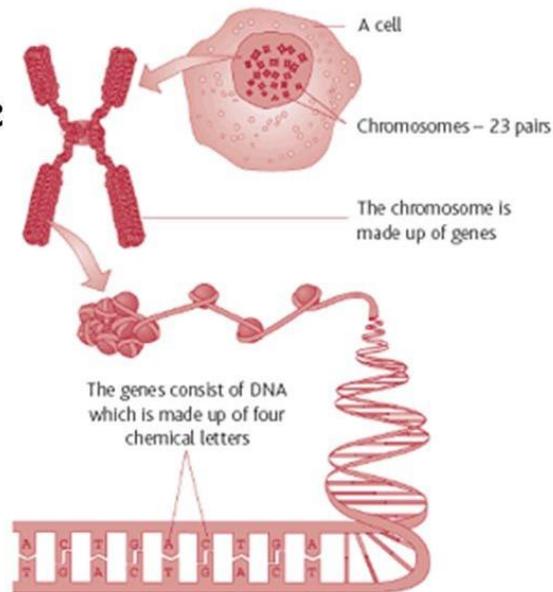
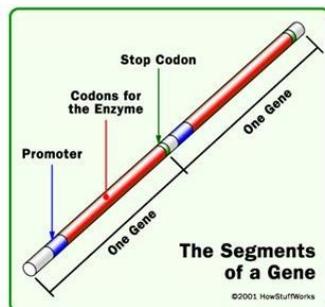


Figure 1: Simple structure of a gene

from parents.

Example Activity: Genetics

Choose a term/phrase from COLUMN B that matches a description in COLUMN A. Write only the letter (A–E) next to the question number (i-iii) in the ANSWER BOOK, for example iii E.

COLUMN A	COLUMN B
i. The action of one gene is modified or controlled by one or several other genes.	A. Pedigree B. Epistasis C. Chromosomes D. Heritability E. GMO
ii. A characteristic of a genetically modified crop.	
iii. Transfer of characteristics from parents to offspring	

Example Activity 1: Genetics Memo

- i. B ✓✓ (2)
- ii. E ✓✓ (2)
- iii. D ✓✓ (2)

Activity 1.1: Genetics Terminology

Various options are provided as possible answers to the following questions. Choose the correct answer and write down only the letter (A-D) next to the question number (1.1.1-1.1.3).

1.1.1.	The following represents a heterozygous genotype in sheep A. Aa B. AA C. Aa D. BB	2
1.1.2.	The visible characteristics produced by an individual's genotype A. Dominant allele B. Recessive allele C. Genotype D. Phenotype	2
1.1.3.	A male animal that has 98 chromosomes will have the following: A. 49 pairs of autosomes and an XY chromosome B. 48 pairs of autosomes and an XY chromosome C. 49 pairs of autosomes and an XX chromosome D. 48 pairs of autosomes and an XX chromosome	2

(6)

(6)

1.2 DIFFERENCE BETWEEN GENOTYPE AND PHENOTYPE

Genotype	Phenotype
Genotypes can be homozygous or heterozygous. Heterozygous genotypes express dominant traits. A recessive trait is expressed if the genotype has two recessive alleles.	The characteristics of an organism which are visible are known as phenotypes. Expression of genes as the external appearance.
Different types of genotype: a homozygous recessive (pp), a homozygous dominant (PP) and Heterozygous (Pp). The homozygous dominant and the heterozygous genotypes show the same phenotypes.	It can be determined by observing the organism.
For e.g., Blood group, eye colour, height, and genetic diseases	For e.g., Weight, physique, and beak of birds
Genotypic ratio: 1TT:1Tt	Phenotype: all white



Parents: RR' X RR'

Genotypic ratio:
1 RR: 2 RR': 1R'R'

Phenotypic ratio:
1 red: 2 roan: 1 white

	R	R'
R	RR	RR'
R'	RR'	R'R'

Figure 2: Genes from parents to offsprings

Activity 1.2: Genetics

Give ONE term for each of the following descriptions. Write only the term next to the question number (1.2.1–1.2.3) in the ANSWER BOOK.

1.2.1.	A genetic cross between parents that have different alleles for one particular gene	2
1.2.2.	The type of inheritance which produces a heterozygous offspring with an intermediate phenotype	2
1.2.3.	The use of statistics to analyse biological data	2

1.3 MONOHYBRID AND DIHYBRID CROSSING

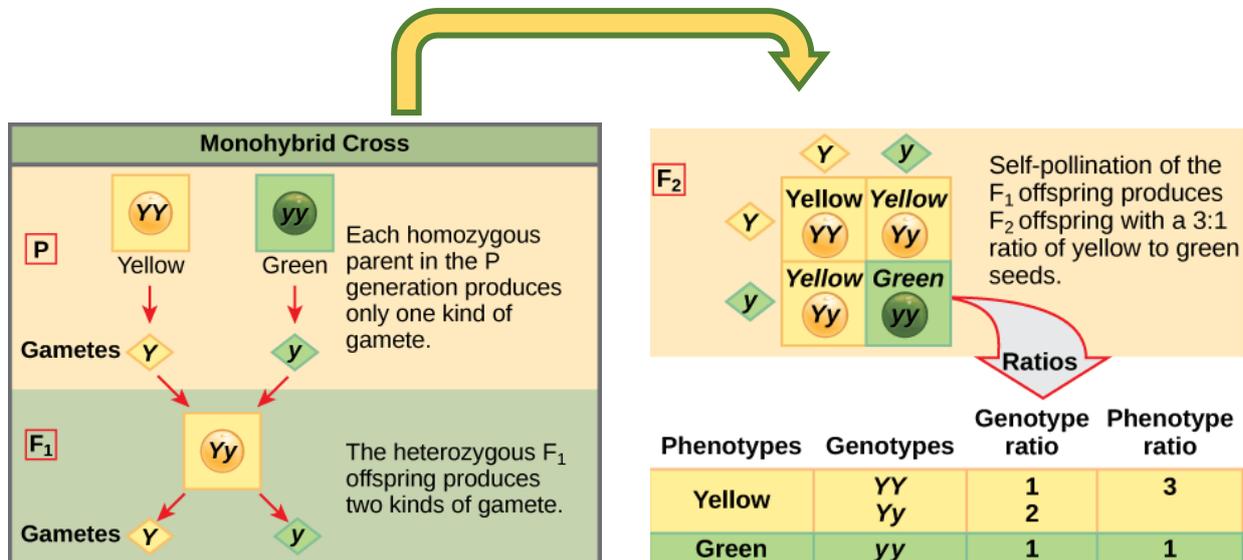
Monohybrid	Dihybrid
Mono refers to single and Hybrid mixed breed	Di refers to two or double and Hybrid means breed
Monohybrid cross is used to study the inheritance of a single pairs of alleles	Dihybrid cross is used to study the inheritance of two different alleles
Used to study the dominance of genes	Used to study the assortment
Genotype ratio: 1:2:1	genotype ratio: 1:2:1:2:4:2:1:2:1
Phenotype ratio: 3:1	Phenotype ratio: 9:3:3:1

Mendel started by focusing on **flower colour**. He worked with pea plants that had the same characteristics except for one trait and pollinated them in a **monohybrid cross**. His experiments included the following steps:

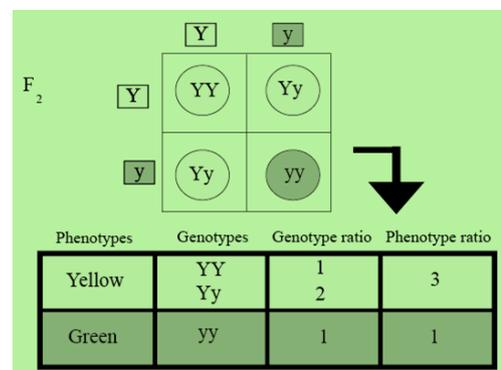
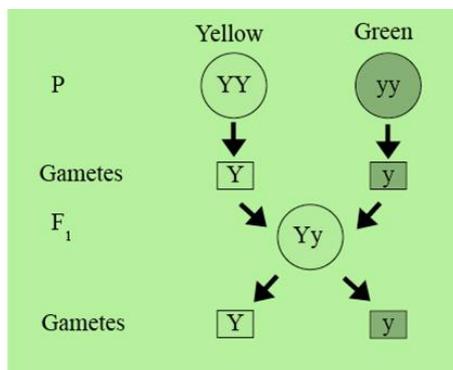
1. Cross-pollinated true-breeding plants, some with purple and some with white flowers.
2. Observed that the first generation or the F1 generation was all purple.
3. Cross-pollinated members of the F1 generation.

4. Observed that three quarters of the second generation or F₂ generation was purple and one quarter was white.

EXAMPLES FOR MONOHYBRID CROSS



For a monohybrid cross of two true-breeding parents, each parent contributes one type of allele. In this case, only one genotype is possible. All offspring are Yy and have yellow seeds (see the figure above).



The Punnett square shown above will help us understand the self-pollination of F₁ to produce the F₂ generation.

Here we observe that 3/4 of offspring produced were having yellow seeds and the rest 1/4 offspring were having green seeds.

Thus, the phenotypic ratio is 3 (yellow seeds):1(green seeds)

Now if we look closely at the Punnett square, we will see that out of the 3 yellow seed-producing plants, 1 is homozygous dominant and 2 are heterozygous dominant. The green seed-producing plant is homozygous recessive.

Thus, the genotypic ratio is 1 (homozygous dominant): 2(heterozygous dominant): 1 (homozygous recessive)

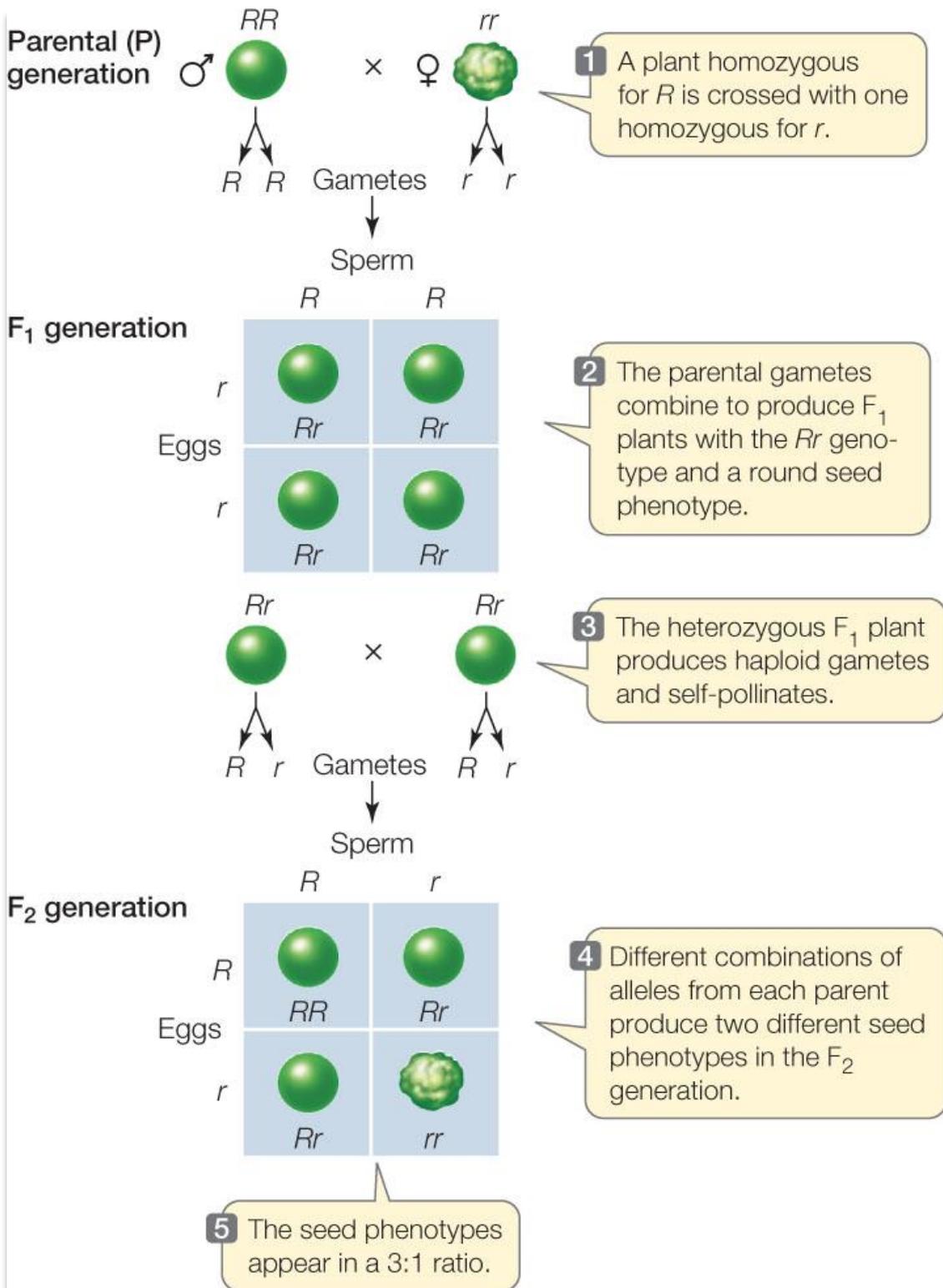


Figure 3: The law of segregation states that: "The two copies of each genetic factor segregate during the development of gametes, to ensure that each parent's offspring attains one factor."

Example Activity: Monohybrid Crossing

A homozygous brown ewe (A) was mated with a homozygous white ram (a). The F1 offspring were all brown. The F1 ewes were mated with an unknown ram and all the F2 generation offspring were brown

- i. Draw a Punnet square to illustrate the F2 generation.
A homozygous brown ewe (A) and a homozygous white ram (a) (4)
- Indicate the following:
- ii. (a) Genotypic ratio of the F2 generation (1)
- iii. (b) The number of white offspring in the F2 generation (1)

Example Activity Memo:

- i. Punnet Square

\	a	a✓	✓
A	Aa✓	Aa	
A✓	Aa	Aa	

Marking Criteria

Correct male gametes ✓

Correct offspring ✓

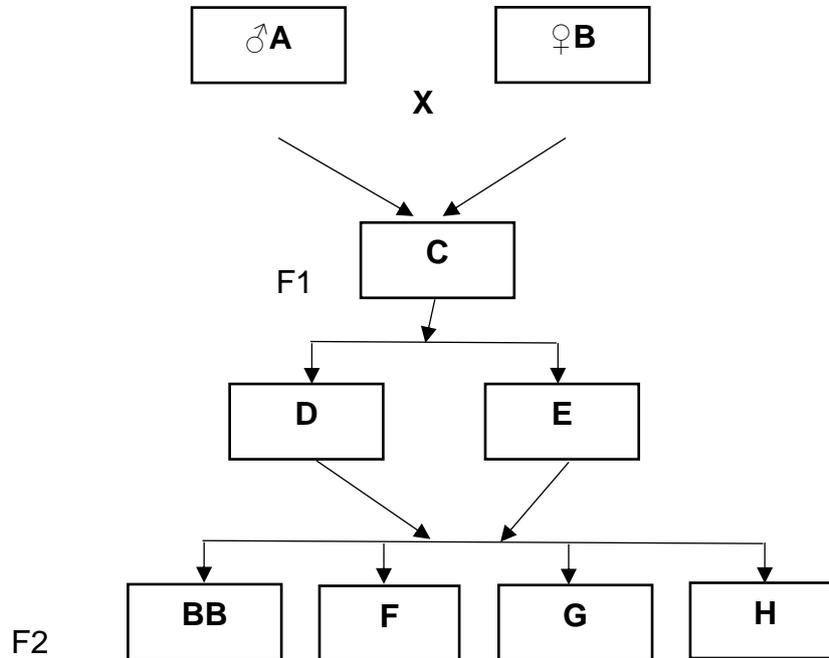
Punnet square with gametes and offspring ✓

All offspring are brown ✓ (4)

- ii. 1:1 or 2:2 ✓ (1)
- iii. 0 ✓ (1)

Activity 1.3: Monohybrid Crossing

A purebred black-faced ram is crossed with a purebred white-faced ewe. **B** represents the ram's face colour, which is dominant over the white face colour of the ewe.



- 1.3.1. Write down the genotype of parent **B**. (1)
- 1.3.2. Indicate whether parents **A** and **B** are homozygous or heterozygous. (1)
- 1.3.3. Give a reason for the answer to QUESTION 2.1.2. (1)
- 1.3.4. Identify the phenotype in the F2 generation, as represented by **F**, **G** and **H**. (3)
- 1.3.5. Indicate the genotypic and phenotypic ratio in the F2 generation. (2)

Activity 1.4: Monohybrid Crossing

A farmer cross-pollinated a heterozygous pea plant with yellow seed (**G**) and a purebred pea plant with green seed (**g**).

- 1.4.1. Indicate the genotype of EACH parent in the first crossing. (2)
- 1.4.2. Use the Punnet square method to determine the possible genotype of the offspring in the first crossing. (3)
- 1.4.3. Name the type of dominance shown by the crossing in QUESTION 1.4.2. (1)
- 1.4.4. Explain a reason for the type of dominance in QUESTION 1.4.3. (2)

1.4.5. Calculate the percentage of heterozygous offspring in the F1-generation. (2)

1.5 Mendel's laws of inheritance

Gregor Mendel conducted several experiments on pea plants and then postulated the laws of inheritance. Mendel's law of inheritance includes the law of dominance, the law of segregation, and the law of independent assortment

Illustrating Mendel's dihybrid crossing diagram

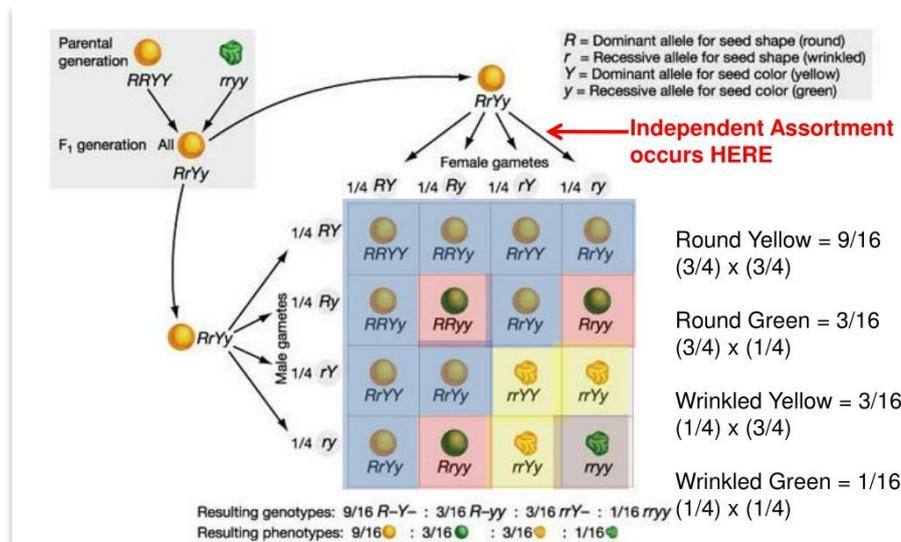


Figure 4 Dihybrid Crossing

Steps/Process

The following are the steps to be followed to conduct a dihybrid cross between two individuals:

1. Selection of parents

- The first step in the dihybrid cross is the selection of characters as well as parents that are to be crossed.
- The pure lines are obtained by selfing the individuals for three generations which confirms the presence of pure lines.



2. Designation for the characters

- The alleles for the two characters selected are designated with certain alphabet characters. The dominant alleles are indicated by upper case letters, whereas the recessive alleles are indicated with lower case letters.



3. Punnet square

- Since gametes are to be formed for fertilization, the gametes are formed. Four distinct gametes are formed while studying the two characters.
- The Punnet square is set up by listing the phenotype and genotype of the parents. The gametes will be haploid because of meiotic division.
- The possible combinations of the genotypes are filled into the Punnet square, and all combinations are equally possible as the process of fertilization is random.



4. Determination of ratios

Once all the combinations are determined, the phenotypic and genotypic ratios of the offspring are noted down.

Activity 1.5: Dihybrid Crossing

The diagram below represents a type of crossing between two pea varieties showing two genes (colour and texture).

Characteristic 1: Colour G – Green g – Yellow	Characteristic 2: Texture R – Rough r - Smooth
--	---

GAMETES	GR	Gr	gR	gr
GR	GGRR	GGRr	GgRR	GgRr
Gr	GGRr	GGrr	GgRr	Ggrr
gR	GgRR	GgRr	ggRR	ggRr
gr	GgRr	Ggrr	ggRr	ggrr

- 1.5.1. Identify the type of crossing above. (1)
- 1.5.2. Give a reason for the answer to QUESTION 1.3.1. (1)
- 1.5.3. Determine TWO possible phenotypes of the F1 generation. (2)
- 1.5.4. Calculate the percentage of offspring that have yellow and smooth pea seeds. Show ALL calculations (2)

CHAPTER 2 PATTERNS OF INHERITANCE

Patterns of inheritance that lead to different phenotypes

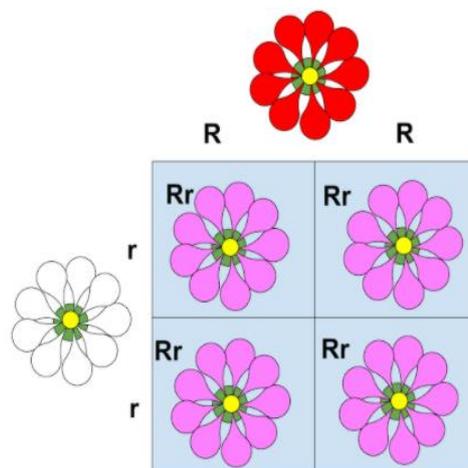
Geneticists later discovered that variations exist on the two patterns of inheritance discovered by Mendel. These lead to different phenotypes that cannot be explained by the simple dominant/recessive relationship shown by Mendel's pea plant experiments.

Types of dominance

Mendel demonstrated simple dominant/recessive inheritance, but there are other types.

Incomplete dominance

Occurs when both alleles of a heterozygous pair influence the phenotype. This

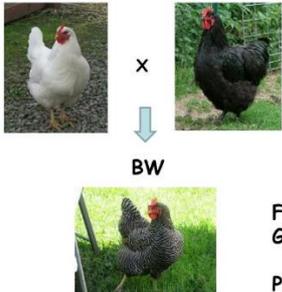


means that the phenotype is halfway between the two homozygous phenotypes.

Co-dominance It's a pattern of inheritance in which both alleles are expressed equally in heterozygous individuals.

Codominance example #2

White hen ww Black rooster BB



	W	W
B	BW	BW
B	BW	BW

BW

Checkered chicken

F1's
Genotypes = 100% BW
Phenotypes = 100% checkered

CODOMINANCE AND MULTIPLE ALLELES

WHITE $R'R'$ RED $R'R$

ROAN $R'R'$

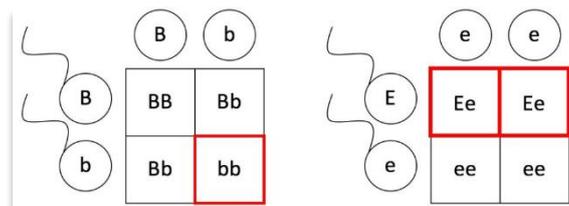
The example of Mendel's tall and short pea plants involves two types of alleles, namely T and t. Some genetic characteristics involve more than two types of alleles. An example of a characteristic determined by multiple alleles is that of coat colour in rabbits. There are four different alleles that each code for a different amount of pigmentation: C+ codes for brown/wild type colouration, c for an albino/no pigmentation, ch for grey/ chinchilla, and Ch for Himalayan/white with dark hair on ears, feet and noses. These various alleles have a dominance hierarchy. For example, C+ will dominate over all the others. Although there are four possible alleles for coat colour, a rabbit can only have two of these.

Polygenic inheritance

Polygenic inheritance occurs when a characteristic is determined by the additive effect of several genes. For example, milk production in dairy cattle is determined by the presence of several genes that influence the quantity of milk produced. Cows with many genes for low production will be poor producers, while those with many genes for high production will produce more milk.

Epistasis

Epistasis is the phenomenon which occurs when genes interact and hide the action of another. This can be seen in the example of coat colour in horses. As with rabbit coat colour, there are several alleles that can influence coat colour in horses. Horses have



genes that block the pigmentation coded for by other genes. This results in the appearance of albino (no pigment) or the various other coat colours, namely red, black or brown.

Prepotency and atavism

These refer to the frequency at which genes appear in a population of plants or animals.

Prepotency

- Is a greater than normal ability of an organism to carry over their genes to their offspring. These can either be external characteristics or production characteristics.
- Prepotency is seen sometimes in pure bred animals because they have many dominant genes.

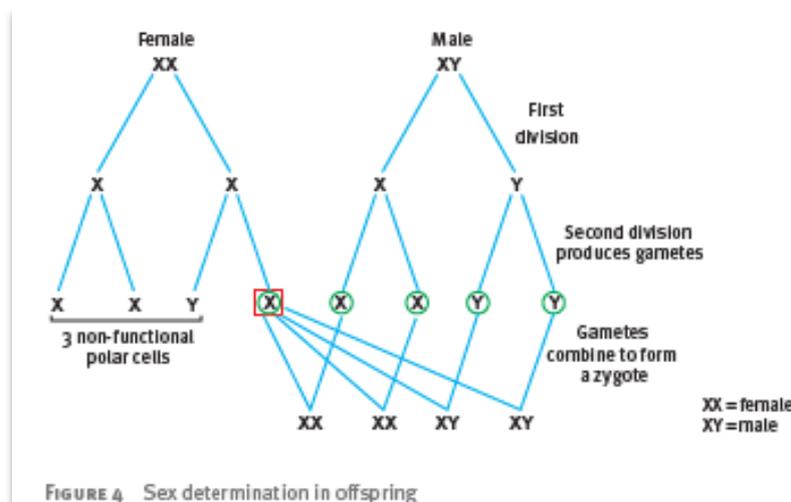
Atavism

- Occurs when a homozygous recessive gene suddenly appears in a population.
- This can be shown by the sudden appearance of a red calf in herd of Black Angus cattle or the sudden appearance of a different coloured flower after several generations.

3. Sex chromosomes and sex-linked characteristics

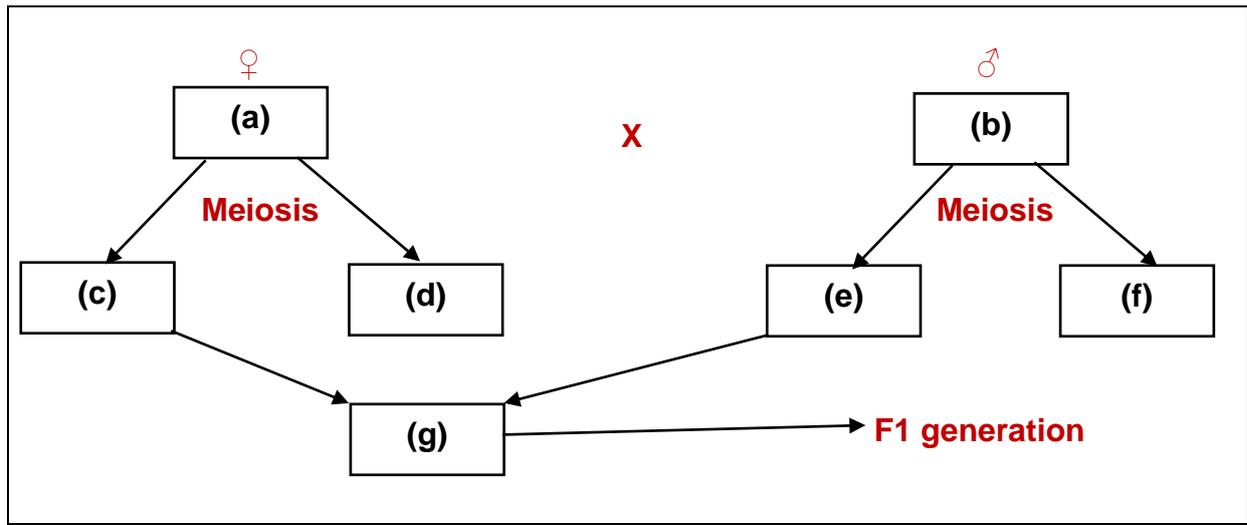
Sex (gender) can be classified as a qualitative genetic characteristic.

- Geneticists have found that female humans and mammals have two X chromosomes while the males have one X chromosome and a small Y chromosome.
- Maleness or femaleness is therefore a genetic phenotype. Extra or missing X and Y chromosomes can cause various problems.
- Humans and animals have a 50:50 chance of producing male or female offspring, which is shown by the genetic diagram below.
- Sex-linked genes are located on the sex chromosomes.



Example Activity 1: Patterns of Inheritance

The crossing of a black (BB) male farm animal and a white (WW) female farm animal gave rise to a heterozygous grey offspring in the F1 generation. The same offspring of the F1 generation were allowed to breed through inbreeding. Their offspring in the F2 generation had a phenotypic ratio of 1 : 2 : 1



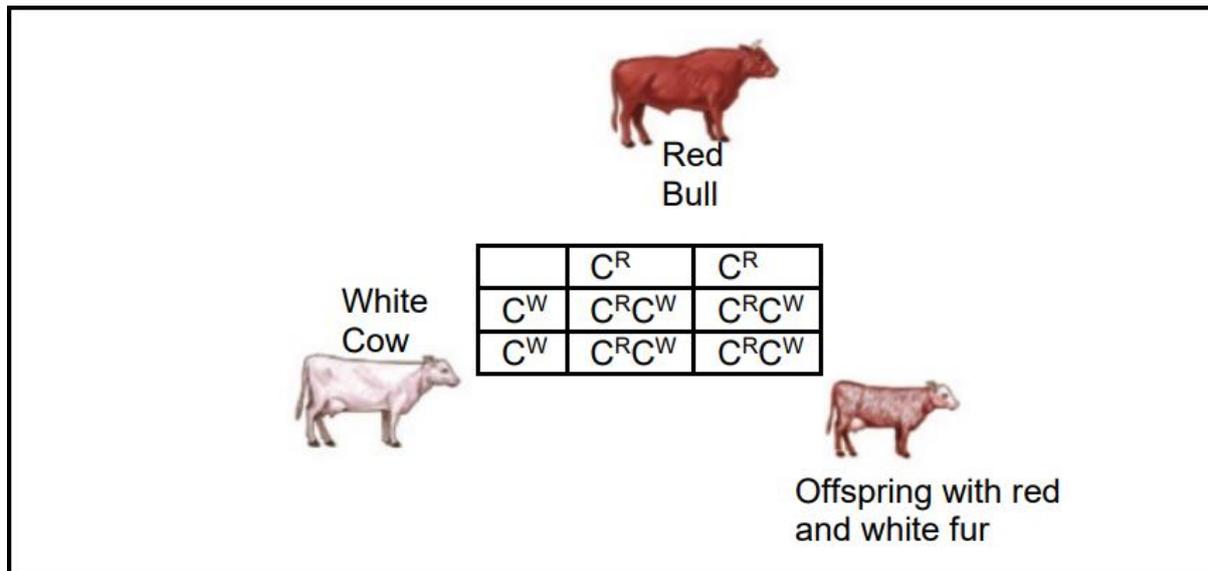
- i. Name the type of dominance illustrated above. (1)
- ii. Give TWO reasons to motivate your answer to QUESTION 2.1.1. (2)
- iii. Complete the diagram and write down the missing genotype at (a), (b), (c), (e) and (g). (5)

Example Activity 1 Memo

- i. Incomplete dominance ✓ (1)
- ii. The offspring inherited none of the colours of the parents/
(No parent is dominant) ✓
The offspring is grey/intermediate/neither black nor white ✓ (2)
- iii. (a) WW ✓
(b) BB ✓
(c) W ✓
(e) B ✓
(g) BW/WB ✓ (5)

Example Activity 2: Patterns of Inheritance

The diagram below shows the outcome of a genetic cross. Analyse and answer the questions that follow.



- i. Identify the mechanism of inheritance depicted in the diagram above. (1)
- ii. Motivate the answer to QUESTION 2.1.1. (2)
- iii. Use a punnet square to determine the genotype of the F₂-generation. (4)
- iv. Deduce the F₂ phenotypic ratio. (1)
- v. Give any TWO other patterns of inheritance that lead to phenotypes that are different to those of Mendel. (2)

Activity 2 Memo

- i. Codominance ✓ (1)
- ii. The characteristics of both homozygote parents ✓ are fully expressed in the phenotype of the heterozygous offspring. ✓ (2)
- iii.

	C^R	C^W ✓
C^R	$C^R C^R$	$C^R C^W$
C^W ✓	$C^R C^W$	$C^W C^W$ ✓

Rubric

Punnet square with gametes and offspring genotypes ✓

Correct male gametes ✓

Correct female gametes ✓

Correct offspring genotype ✓ (4)

- iv. 1 Red: 2 Red and white: 1 white ✓ (1)

- v. • Incomplete dominance ✓
 • Multiple alleles ✓
 • Polygenes ✓
 • Epistasis ✓ [any 2] (2)

Activity 2.1: Patterns of Inheritance

The statements below show different patterns of inheritance:

- (a) An animal with a phenotype that is between the phenotype of both parents
- (b) Both black and red colours are visible on the coat of an animal

(c) The animal has a brown coat like the parent

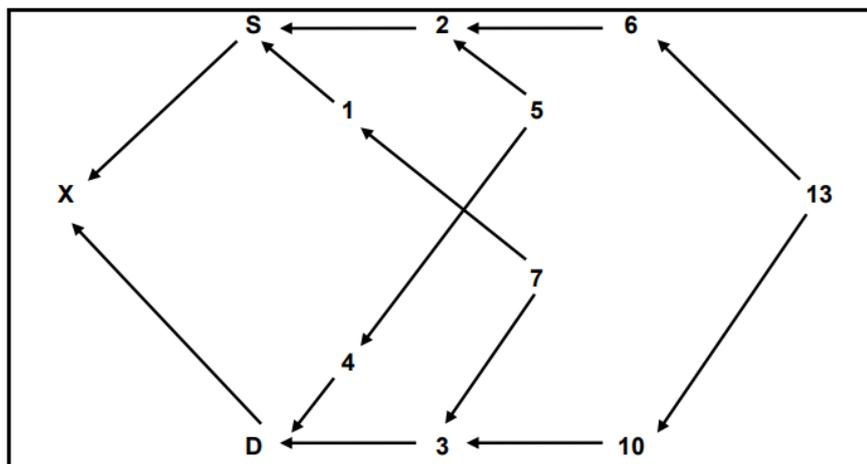
2.1.1. Match statements (a), (b) and (c) with the types of dominance. (3)

2.1.2. Identify the genetic phenomenon of inheritance in QUESTION 4.5(c). (1)

2.1.3. State TWO patterns of inheritance, other than those identified in QUESTION 4.5.1(a) to (c). (2)

Activity 2.2: Patterns of Inheritance

The flow chart below is a schematic representation of line breeding



2.2.1. Identify TWO common ancestors of individuals S and D in the schematic representation above. (2)

2.2.2. Explain TWO ways in which livestock farmers could benefit from upgrading by using a pure-bred breed in their commercial crossbred herd. (2)

CHAPTER 3: VARIATION & MUTATION

3.1 WHAT IS VARIATION

Difference between individual organisms, or groups of organisms of any species caused either by genetic differences (genotypic variation) or by the effect of environmental factors on the expression of the genetic potentials (phenotypic variation).

Variation may be shown in physical appearance, fertility, behaviour and any other measurable characters.

Genotypic variation	Phenotypic variation
Are caused by differences in number of genes carried by the chromosomes.	Are environmentally caused variation These variations do not involve any hereditary alteration and in general are not transmitted to future generations; consequently, they are no
* Eye colour body form. * disease resistance Individuals	* food * climate

Variations are classified either as continuous, or quantitative such as height difference or as discontinuous, or qualitative (composed of well-defined classes, as [blood groups](#) vary in humans). A discontinuous variation with several classes, none of which is very small, is known as a [polymorphic variation](#). The separation of most higher organisms into males and females and the occurrence of several forms of a [butterfly](#) of the same species, each coloured to blend with a different vegetation, are examples of polymorphic variation.

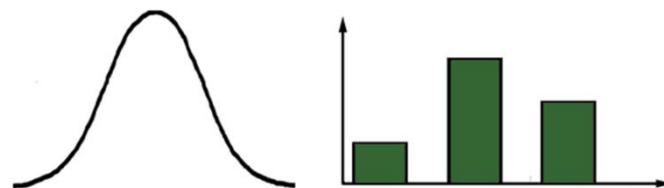
3.1.1. Types of variations

- **Continuous variation** – those characteristics where there is a **range** of (*the word range must be emphasized and taught – light yellow red or dark red*) (*intermediate phenotypes* e.g. height)

- **Discontinuous variation** – those characteristics that fall into *distinct categories* e.g. blood groups

(Example: A farmer wants to produce red apples, yellow apples, or red and yellow apples – what kind of variation is this – this is discontinuous variation because they must either be red, yellow or red, yellow)

3.2. WHAT IS MUTATION?



Continuous Variation

- No distinct categories
- Tends to be quantitative
- Controlled by a lot of genes
- Strongly influenced by the environment

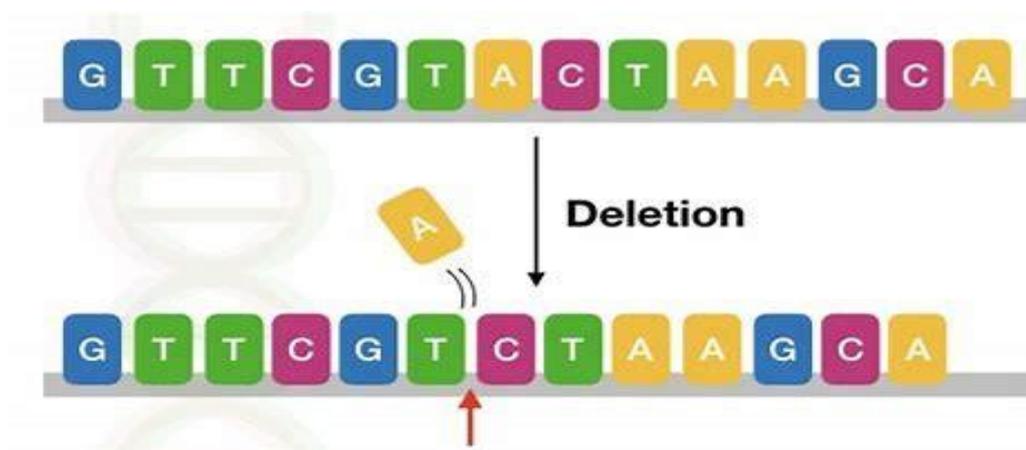
Discontinuous Variation

- Distinct categories
- Tends to be qualitative
- Controlled by a few genes
- Unaffected by the environment

mutations refer to changes in chromosomes and genes, which typically manifest physically.

3.2.1. Types of mutation:

- Gene mutation- **mutation breeding** uses a plant's own genetic make-up, mimicking the natural process of spontaneous mutation. The mutation process generates random genetic variations, resulting in mutant plants with new and useful traits. Gene mutation include:
- Deletion- where one or more nucleotide bases are removed from the gene sequence

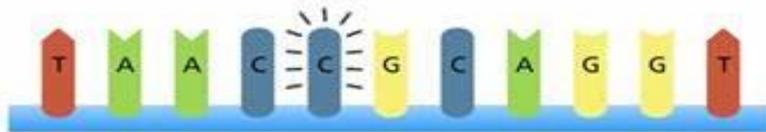


- Insertion- one or more nucleotide bases are added into the gene sequence

Original sequence



Point mutation



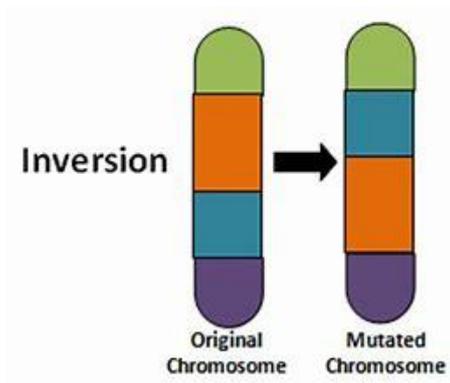
- Substitution – one nucleotide base is replaced with a different nucleotide base



Substitution



- Inversion- the order of two or more nucleotide bases is reversed



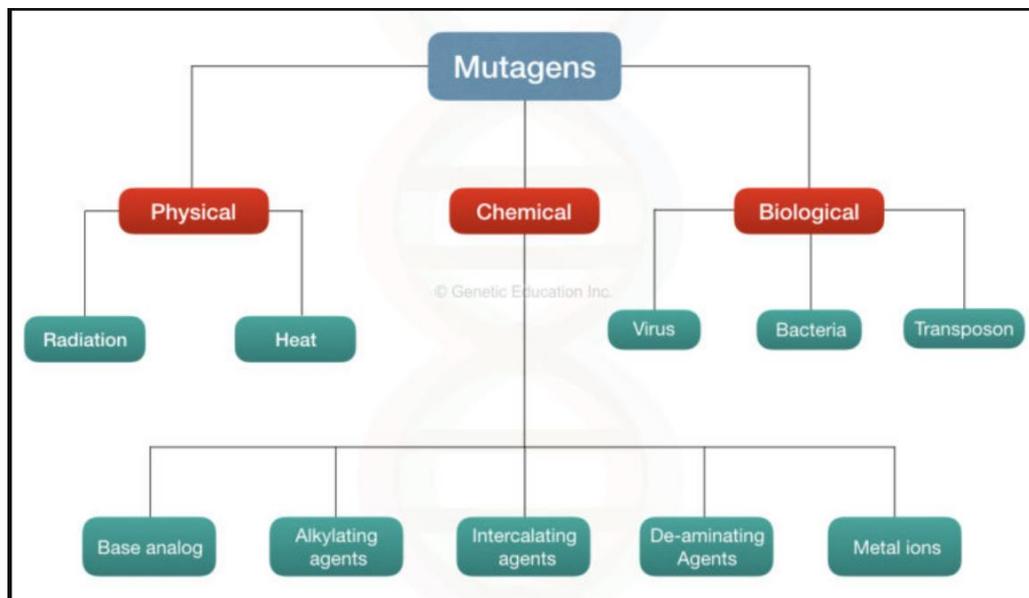
3.2.2. Causes of mutation

- Natural and induced mutations

INDUCED MUTATION VERSUS SPONTANEOUS MUTATION

INDUCED MUTATION	SPONTANEOUS MUTATION
A mutation that is produced by treatment with a physical or chemical agent that affects the deoxyribonucleic acid molecules of a living organism	A mutation that arises naturally and not as a result of exposure to mutagens
Occur due to mutagens from the environment	Occur due to natural causes
Occur due to the incorporation of base analogs, base mispairing, and base damage	Occur due to errors in DNA replication, spontaneous lesions like depurination and deamination, and transposable genetic elements
Important in reverse genetics	Important in forward genetics
	Visit www.PEDIAA.com

3.2.3. Mutagens and their effects



3.3. Importance of mutation

Plant breeding requires genetic variation of useful traits for crop improvement. The induction of mutations has been used to **enhance the yield**, better nutritional quality and wider adaptability of world's most important crops such as wheat, rice, pulses, millets and oilseeds.

Example Activity 3.1: Variation and Mutation

3.1. Variation refers to the differences in characteristics between members of the same species. The differences may be caused by both external and internal factors.

Name the environmental factor that has led to EACH of the following variations:

- 3.1.1. Animals at higher altitudes have darker pigmentation than those at lower altitudes. (1)
- 3.1.2. Animals are shorter than other animals with the same gene for tallness due to a nutrient deficiency. (1)
- 3.1.3. Goats kept on steeper slopes have longer and stronger legs than goats kept on flatter slopes. (1)
- 3.1.4. Herefords kept in colder regions have thicker hair than those found in warmer regions. (1)

Example Activity 3.1 Memo

- 3.1.1. Light intensity/temperature/climate ✓ (1)
- 3.1.2. Feeding/nutrition ✓ (1)
- 3.1.3. Topography/relief/terrain ✓ (1)
- 3.1.4. Climate/low temperature ✓ (1)

Activity 3.1: Variations and Mutations

3.1. Genotypically identical maize seeds were planted in different areas of the province. The seeds were planted at the same time. The table below shows the height of the maize plants after three months.

AREA	HEIGHT
A	Tall
B	Dwarf
C	Medium

- 3.1.1. Indicate the genetic phenomenon illustrated in the table above. (1)
- 3.1.2. Define the genetic phenomenon in QUESTION 3.1.1. (2)
- 3.1.3. Name THREE environmental factors that may have contributed to the difference in height of the maize plants. (3)
- 3.1.4. If two different cultivars of maize are crossed the offspring normally shows a very large and drastic improvement in yield. Give a scientific term for this improvement. (1)

Activity 3.2: Variations and Mutations

The effects of genotype and feeding on the growth performance of broilers were investigated. Two different types of broilers were used. Feed restriction resulted in lowered feed conversion rate and less average weight gain.

- 3.2.1. Identify the following by referring to the scenario above:
 - (a) Genetic factor of variation (1)
 - (b) Environmental factor of variation (1)
- 3.2.2. Refer to the above scenario and explain the relationship between feed restriction and average weight gain. (2)
- 3.2.3. Formulate a hypothesis of this investigation. (2)

CHAPTER 4: SELECTION AND BREEDING

PRINCIPLES OF SELECTION

Selection Methods and Breeding Values

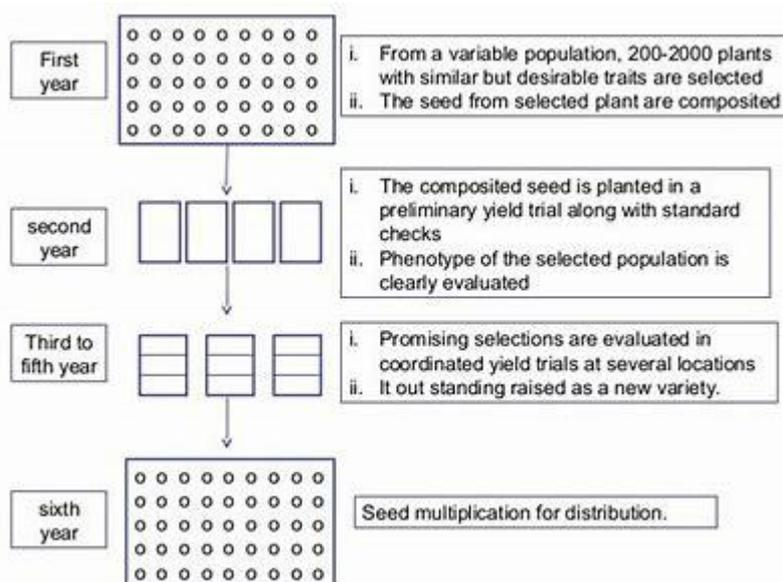
Breeders can use various selection methods for breeding to obtain the plants and animals with the desired characteristics. Modern selection methods use breeding values (BV).

Mass selection

- Also called individual selection. The individuals are selected for breeding based on their performance.

Pedigree selection

- Breeding stock is selected based on the performance of their forebears.

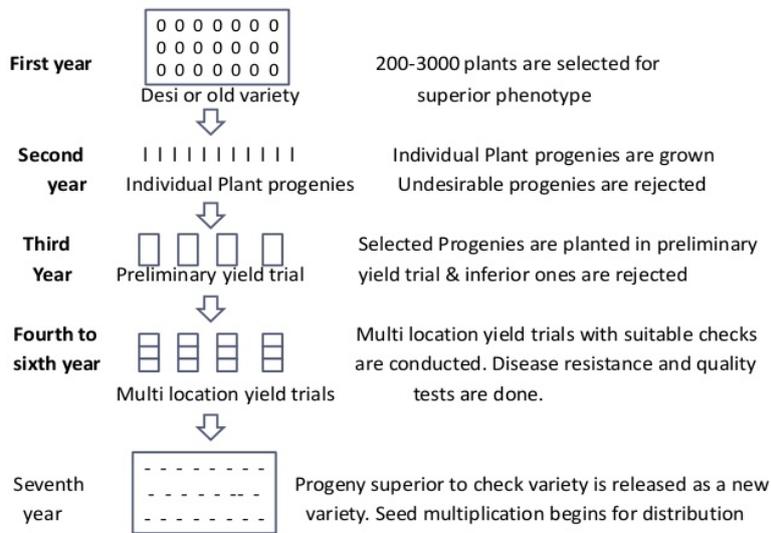


Family selection

- It's similar to pedigree selection but involves comparing siblings. They can either be full siblings that have the same mother and father or half siblings that share only one parent.

Progeny selection

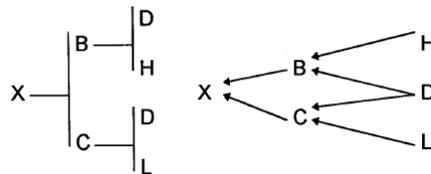
- Based on the performance of the offspring of the individual. The individual is selected for breeding if the progeny shows the desired characteristics during progeny testing. BVs are used to determine the suitability of the parents



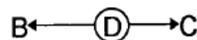
THE FOLLOWING BREEDING SYSTEMS AND TERMINOLOGY: With examples

- **Breeding:** Process of producing plants or animals by sexual reproduction.
- **Inbreeding:** The crossing of two plants or animals that are closely related.
E.g. Father and daughter, mother and son, brother and sister.

A **common ancestor** is an individual that appears on both the sire and dam sides of the pedigree. Whenever a common ancestor is inbred, his/her inbreeding coefficient (F_A) will have to be calculated before the inbreeding coefficient of individual X (F_X) can be determined. Calculation of an inbreeding coefficient involves several steps:

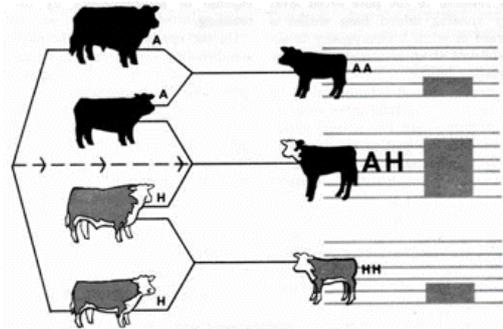


- Step 1:** Generate an arrow pedigree.
- Step 2:** List all paths that connect the sire and dam.
- Step 3:** Locate the common ancestor in each path.

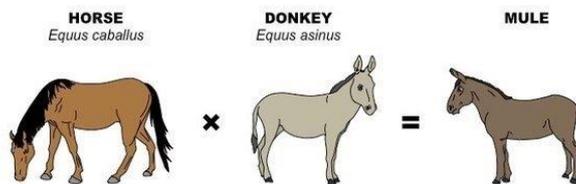


- **Cross-breeding:** The breeding of two plants or animals that are not closely related. / is the mating of two purebred animals of different breeds.
 - Practiced by stock farmers to obtain hybrids.

- It's the mating of two pure-bred animals of different breeds, but of the same species.
- E.g. Afrikaner bull X Aberdeen Angus cow =
- Heterosis or hybrid cow
- Hereford bull X Afrikaner cow=
- Bonsmara Shorthorn bull X Afrikaner cow = Bonsmara

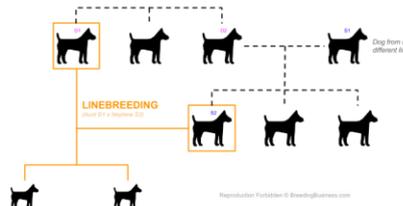


- **Species-crossing:** Is the mating of individuals of two different species.
 - E.g. A horse mated with a donkey produces a mule.
 - Or Donkey stallion X horse mare = mule
 - Uses of the MULE:
 - Used as draught animals for pulling implements/ploughing/working.
 - To carry loads/Transport.



Out-crossing/out-breeding: Is the mating of unrelated animals or of animals that are not closely related.

- **Line-breeding:** Is the breeding of animals that share common ancestors, but which are not closely related.



- **Upgrading/Grading up:** Is the repeated mating of thoroughbred (purebred) male animals with inferior female animals. Excellent pure-bred males of a specific breed are mated generation after generation with females of inferior quality.

Advantages and disadvantages of breeding systems

Breeding system	Advantages	Disadvantages
Inbreeding	Produces uniform animals/plants	Recessive defects become apparent; Reduction in vigour
Line-breeding	Produces uniform animals and less defects than inbreeding	Less hybrid vigour than cross breeding
Outcrossing	Brings desired characteristics into pure breeds	Less hybrid vigour than cross breeding
Cross breeding	Gives rise to hybrid vigour; Introduces new desirable traits	F1 hybrids have maximum effect after which hybrid vigour declines
Upgrading	Improves poor quality animals quickly	Effect slows down after a few generations
Species-crossing	Produces new plant/animal species	Animal species crosses are infertile

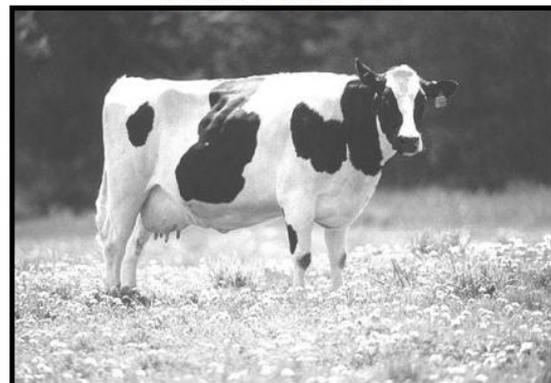
Example Activity: Breeding Systems

The pictures below show two different breeds of farm animals.

BEEF BREED



DAIRY BREED



- i. Name the breeding system if the animals in the pictures above are allowed to breed. (1)
- ii. Give a reason for the answer to QUESTION 4.1.1. (1)
- iii. State TWO advantages of the breeding system in QUESTION 4.1.1. (2)
- iv. Name TWO disadvantages of inbreeding.

Example Activity Memo

- i. Crossbreeding ✓ (1)
- ii. Different/unrelated breeds of the same species are crossed/beef breed crossed with dairy breed ✓ (1)
- iii. Increases genetic variation ✓
• Produce heterosis/hybrid vigour/improved performance ✓ (2)
- iv. Loss of genetic variation ✓
• Leads to inbreeding depression ✓
• Increases the expression of lethal genes/deformities/unwanted genes ✓
• Increases homozygosity ✓ [Any 2] (2)

Example Activity: Selection

The table below shows heritability of different characteristics in farm animals.

HEREDITARY CHARACTERISTIC			
	Milk production	Eye Colour	Fleece Weight
HERITABILITY (%)	40	70	20

- i. Define the term heritability. (2)
- ii. Identify the following from the table above:
 - (a) Qualitative characteristic (1)
 - (b) Quantitative characteristic (1)

- iii. Indicate the percentage of environmental effect on milk production. (1)
- iv. Explain the relationship between heritability and the estimated breeding value (EBV). (2)

Example Activity Memo: Selection

- i. The degree to which a characteristic is determined by genetic factors ✓ (2)
- ii. (a) **Qualitative** - Eye colour ✓ (1)
(b) **Quantitative** - Milk production/fleece weight ✓ (1)
- iii. 60% ✓ (1)
- iv. The higher the heritability of the trait ✓ the higher the estimated breeding value ✓
 - The lower the heritability of a trait ✓ the lower the estimated breeding value ✓ [any 1] (2)

Activity 4.1: Breeding Systems

Indicate the breeding system applicable to EACH of the situations below:

- 4.1.1. Results in a large increase in the performance of the offspring (1)
- 4.1.2. Leads to a gradual decrease in the performance of the offspring from generation to generation (1)
- 4.1.3. New breed is gradually brought into a new environment with fewer adaptation problems (1)
- 4.1.4. Gives rise to sterile progeny (1)

Activity 4.2: Breeding

Different breeding systems used by famers to improve the performance of their breeding stock are indicated below.

inbreeding; crossbreeding; species crossing; outcrossing; line breeding

- 4.2.1. Match the breeding systems above with EACH of the following statements:

- (a) Pure-bred Holstein bull x pure-bred Holstein cow who are not from the same line (1)
- (b) Produce offspring that is sterile (1)
- (c) The progeny produces better than the parents (1)
- (d) Undesirable characteristics can be bred into the progeny (1)

4.2.2. Name TWO main types of mutagenic agents that can affect the breeding systems above. (2)

Activity 4.3: Selection

Two cultivars, CULTIVAR A and CULTIVAR B, are crossed. CULTIVAR A has short stems and fleshy fruit that ripen quickly, while CULTIVAR B has long stems and the fruit takes long to ripen with less juice.

- 4.3.1. A very large and drastic improvement in yield was achieved when CULTIVAR A was crossed with CULTIVAR B. Give the genetic term referring to the improved yield. (1)
- 4.3.2. Explain why the two cultivars above are used in this breeding programme. (2)
- 4.3.3. State TWO factors which influence the variation in the cultivars above. (2)
- 4.3.4. Give TWO reasons why variation in plant breeding is important. (2)

Activity 4.4: Selection

Wild plant A population evolve to cope with changes in their environment.	Humans identify B desirable traits in plants and animals and take steps to enhance them.
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- 4.4.1. Identify the selection types **A** and **B**. (2)
- 4.4.2. Give TWO methods of selection type **B**. (2)
- 4.4.3. Specify TWO requirements for characteristics used in selection type **B**. (2)

CHAPTER 5: GENETIC MODIFICATION: DEFINITION

Genetic modification is any process by which genes are manipulated, changed, deleted or adjusted to amplify, change or adjust a certain characteristic of an organism. It is the manipulation of traits at the absolute root – or cellular – level.

- A gene, from a basic biochemical standpoint, is a segment of deoxyribonucleic acid (DNA) inside every cell of an organism that carries the genetic code for assembling a particular protein product.
- On a more functional and dynamic level, genes determine what organisms – animals, plants, fungi and even bacteria – are and what they are destined to develop into.
- While the behaviour of genes is influenced by environmental factors (e.g., nutrition) and even by other genes, the composition of your genetic material overwhelmingly dictates almost everything about you, visible and unseen, from the size of your body to your response to microbial invaders, allergens and other external agents.
- The ability to change, modify or engineer genes in specific ways would therefore introduce the option of being able to create exquisitely tailored organisms – including humans – using given combinations of DNA known to contain certain genes.

Conventional breeding relies primarily on selection, using natural processes of sexual and asexual reproduction. Genetic engineering utilizes a process of insertion of genetic material, via a gene gun or other direct gene introduction methods, or by a specially designed bacterial truck, which does not occur in nature.

Difference between conventional breeding and Genetic modification

Conventional breeding	Genetic modification
With conventional breeding, traits can only be transferred between plants or animals of the same or closely related species.	GM enables traits to be transferred between different species, and potentially even between animals and plants species.
This method requires a lot of effort and is rather imprecise.	Genetic modification is quite precise

The three principal methods used for the creation of transgenic animals are:

- **DNA microinjection**

Microinjection is a technique in which recombinant DNA is directly injected into the nucleus of an animal. In this, through a glass micropipette, foreign DNA is

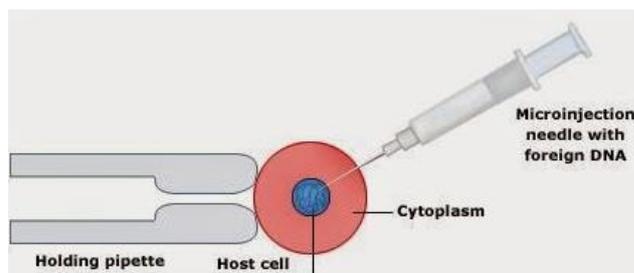


Figure 5: Micro Injection of a fertilised egg cell with desired genes

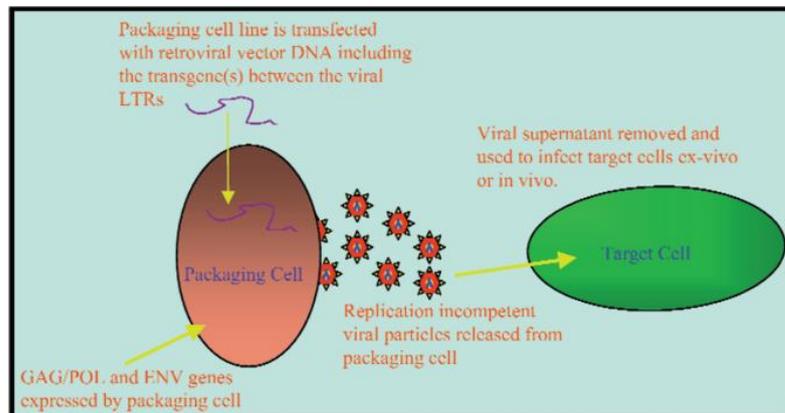
delivered directly into a living cell, oocyte or embryos of animal.

- **Embryonic stem cell-mediated gene transfer**

This method involves prior insertion of the desired DNA sequence by **homologous recombination** into an in vitro culture of embryonic stem (ES) cells. Stem

- **Retrovirus-mediated gene transfer**

It's a type of [virus](#) that inserts a DNA copy of its [RNA](#) genome into the [DNA](#) of



a [host cell](#) that it invades, thus changing the [genome](#) of that cell.

Potential advantages of GMO crops include Trusted Source:

- Increased attractiveness to consumers, for example, apples and potatoes that are less likely to bruise or turn brown
- Enhanced flavour
- Longer shelf life and therefore less waste
- Greater resistance to viruses and other diseases, which could lead to less waste and increased food security
- Greater tolerance to herbicides, making it easier for farmers to control weeds
- increased nutritional value, as in golden rice, which can boost the health of people with limited access to food
- Greater resistance to insects, allowing farmers to reduce trusted source pesticide use
- ability to thrive in a harsh climate, such as drought or heat
- Ability to grow in salty soil

Cons

Genetically engineering foods is a relatively new practice, which means the long-term effects on safety are not yet clear.

Many concerns about the disadvantages relate to human health. Scientists have not yet shown that GMO foods are harmful to health, but research is ongoing.

Are GMO foods good or bad for the environment?

Climate change and severe weather events [are disrupting](#) food production and supply. GMO foods could help maintain supplies in the face of changing environmental conditions and a growing population.

Pros

Genetically modifying some foods could make them:

- easier to store and transport
- less prone to waste due to disease and aging
- more likely to grow in areas with poor quality soil
- higher in nutrients

Cons

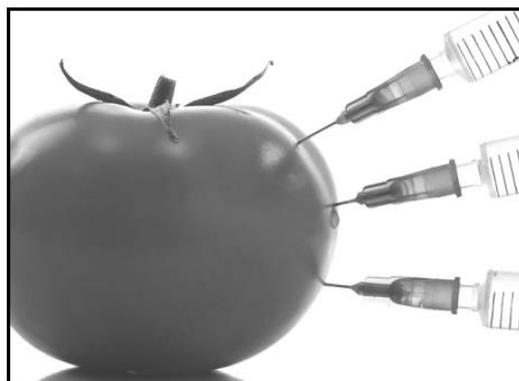
Environmental concerns:

- the risk of outcrossing, where genes from GMO foods pass into wild plants and other crops
- a negative impact on insects and other species
- reduction in other plant types, leading to a loss of biodiversity

The risks will vary depending on local conditions.

Example Activity: Genetic Modification

The illustration below shows a technique used by farmers to genetically modify tomatoes.



- i. Identify the technique above.

(1)

- ii. State TWO advantages of the technique in QUESTION (i) for the farmer. (2)
- iii. Suggest TWO socio-economic implications that plants produced from the technique in QUESTION (i) and other related techniques have for the farmer. (2)

Example Activity Memo

- i. Genetic modification/engineering/manipulation/micro-injection ✓ (1)
- ii. Better yield/harvesting ✓
 Increased shelf life/storage ✓
 Improved quality/increased nutritional value/value adding ✓
 Increased resistance to diseases/insects/pests ✓
 Resistance to harsh conditions/drought ✓ [any 2] (2)
- iii. Small scale and poor farmers cannot afford GM crops/GM crops are expensive ✓
 A farmer is not allowed to re-use seeds from GM crops ✓
 The farmer may not use some seeds as they are sterile ✓
 Some consumers will not buy from the farmer due to ethical concerns ✓
 It encourages monopoly which does not allow small companies to develop/favours the producers and encourages exploitation of emerging farmers ✓ [any 2] (2)

Activity 5.1: Genetic Modification

The yield obtained by farmers in a typical maize-growing area using conventional hybrid seed, is lower than the latest available genetically modified technology which uses genetically modified seeds.

- 5.1.1. Name TWO techniques used to develop genetically modified plants. (2)

5.1.2. Differentiate between conventional hybrid seed and genetically modified seed. (2)

5.1.3. State THREE advantages of genetic engineering. (3)

Activity 5.2: Genetic Modification

5.2.1. Name TWO techniques that can be used to modify plants. (2)

5.2.2. State TWO advantages of GM crops. (2)

5.2.3. Indicate TWO disadvantages of GM crops. (2)

AGRICULTURAL MARKETING: EXAMINATION GUIDELINES



- Define market/marketing.
- Distinguish between marketing and selling.
 - List, identify and describe the main functions of agricultural marketing
 - Terminology: demand and supply
 - The Law of demand and the law of supply
 - Interpretation of demand and supply curves
 - Factors influencing demand and supply of goods
 - Price elasticity demand/supply and price inelasticity of demand/supply
 - Price determination with and supply and demand
 - Explanation of demand/supply schedule/curves/graphs
 - Interpretation of Price elasticity of demand and supply
 - Free Market(Concept of free marketing, the general advantages and disadvantages)
Farm gate market, fresh produce market, Internet sales, Direct marketing, and internet marketing.
 - Cooperative marketing (The concept of agricultural cooperatives, types of agricultural cooperatives, principles,benefits/advantages.

1.



IMPORTANT TERMS AND DEFINITIONS

Market	An entire number of buyers and sellers in an area being considered .
Marketing	All the processes involved including planning promotion, and distribution of goods or ideas to the customers/consumers.
Market equilibrium	A market situation where demand and supply of goods is the same.
Selling	The exchange of goods and services for money
Bartering	Exchange of goods for goods
Buying	Obtain a product or service in exchange for payment.
Processing	The conversion and modification of product in order to add value.
Demand	Refers to quantity of goods that consumers are willing and able to buy at different prices.
Supply	Quantities of goods that producers are willing and able to sell or produce at different prices.

Price Elasticity	Refers to the quantity response to a change in price.
Law of demand	All other factors being equal, as the price of a good increases, demand for the good or service will decrease./ As the price of a good decrease, more of the good will be bought by consumers.
Law of supply	All other things being equal, an increase in price leads to an increase in the quantity of goods supplied./ Lowering prices lead to quantity of good sold being lowered.
Hedging	A market price risk management strategy where the market price is kept constant.
Free marketing	A form of marketing where producers market their produce as they wish
Cooperative marketing	It is when producers pool their products and market them through the cooperative society.
Controlled marketing	It refers to the management of the distribution of goods and services by government or other agencies.
A cartel	Refers to a group of producers sell their produce as a unit resulting in price manipulation.
Price fixing	When group of producers collaborate and set prices artificially



CONCEPT OF MARKET/ MARKETING

Market refers to an entire number of buyers and sellers in an area.

Marketing refers to all the processes involved including planning promotion, and distribution of goods or ideas to the customers/consumers.

DIFFRENCES BETWEEN SELLING AND MARKETING

The main difference between selling and marketing is that selling involves the procedure where goods or services are traded for money whilst marketing involves in activities and plans that businesses use to promote the selling or buying of a product or service.

Attributes	Selling	Marketing
Orientation	Generating high sales volumes	High profits
Focus	Needs of seller	Needs of buyer
Planning	short term	Long term
Emphasis	Product	Customer wants.
Price	The cost determines the price	Consumers determine the price

AGRICULTURAL MARKETING FUNCTIONS

Agricultural produce must undergo a series of transfers or trade from one hand to another before it eventually reaches the consumer. This is achieved through four important marketing functions which are :

- 1 Transport,
- 2 Storage,
- 3 Packaging, and
- 4 Processing/value adding.

Transport

Agricultural produce must be transported from production point assembly point and finally to the consumer or market. .Different modes of transport can be used based on the nature of produce. These include rail, road, air and sea.

Fresh produce such as vegetables, fresh fruit, meat, and milk. may be transported by road will require refrigerated transport to avoid spoilage in transit Air transport may be required for cut flower and other highly perishable produce.



A truck transporting maize

Storage

Some agricultural produce like grapes must be stored before packaging and processing soon after harvesting to prevent spoilage. Farmers may use on-farm storage facilities or use another party such as a processor to keep his produce until ready for the market.



Picture of silos being used to store grains.

Advantages of Storage

- Closes the gap between producers and consumers.
- Ensures fresh produce.
- Helps to control prices by keeping them at constant levels.
- Creates jobs.
- Reduces the time between production and purchasing.
- Helps maintain the supply and demand of products.

Packaging

Most agricultural produce is packaged before transporting. The purpose of packaging is to help farmers and packers of fruits and vegetables to choose the optimum packaging for their produce to improve shelf life and quality of the product and reduce loss in the supply chain.



Maize meal



A box of apples

Guidelines for Packaging fresh produce

It should improve shelf life.

Use environmentally friendly material which must be degradable, if possible, to address environment concerns. The materials used should be environmentally friendly and either biodegradable or recyclable, but also strong and easy to handle.

The product should fit well in the container in which it is packaged.

It must identify the product and appeal to customers.

The package should be appropriately designed for the target market.

Advantages of packaging

- It improves shelf life.
- It gives the product strong market appeal.
- It promotes the trademark.

Important aspects of packaging fresh produce

1 Protection

Most fresh produce is highly perishable and easily damaged. The package must protect produce from mechanical damage and poor environmental conditions during handling and transportation

2 Identification

Packaging must identify and provide useful information about the produce such as product name, size, quantity producer and brand.

3 Containment

Containers must be clean, dry and relevant for the type of product

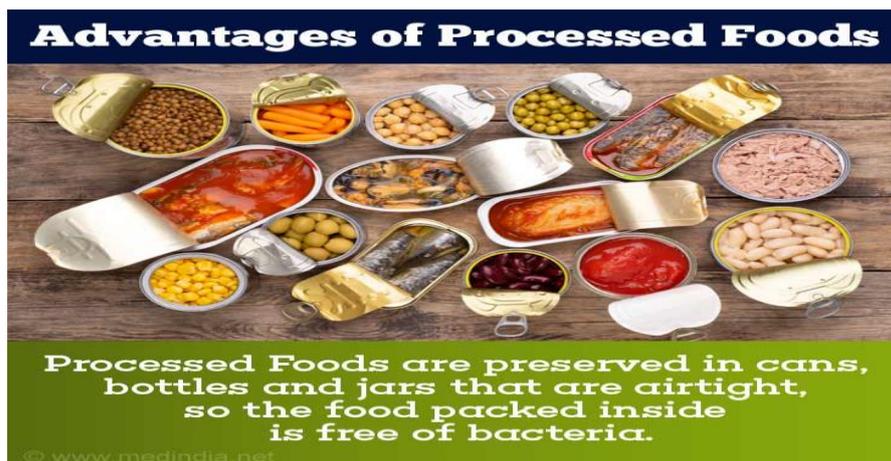
There should be no odour, or importation of foreign objects to the produce being packaged. It must be rigid and be able to support the product and keep the original product in its shape and must allow rapid cooling of the product.

4 Processing

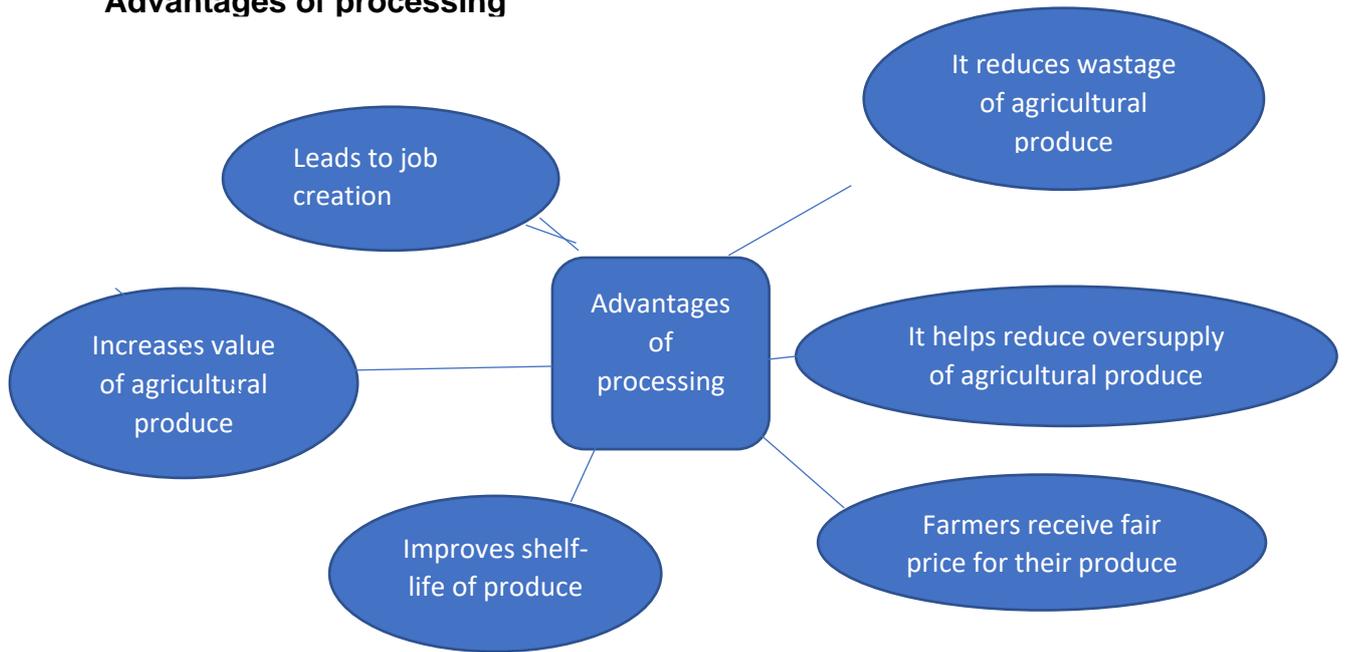
Processing/value adding.

Processing includes changing a product from its raw form into a new type that is easier for the consumer to use. Examples of processing include milling maize, preparing sausage, canning tomatoes and making orange juice and drying fruits.

Examples of processed foods



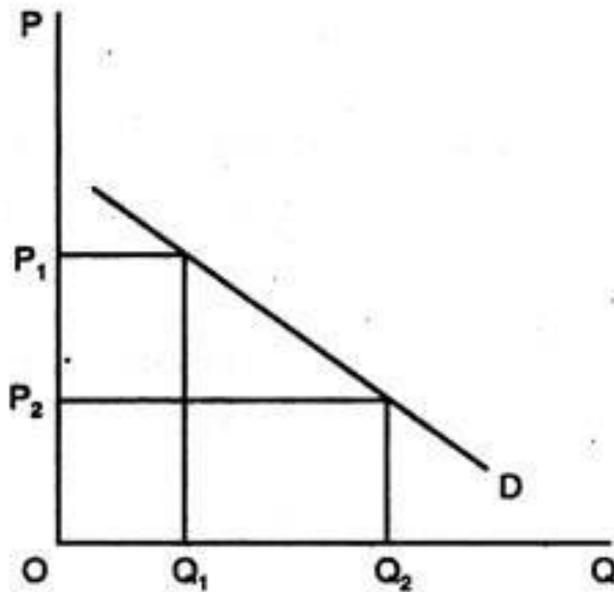
Advantages of processing



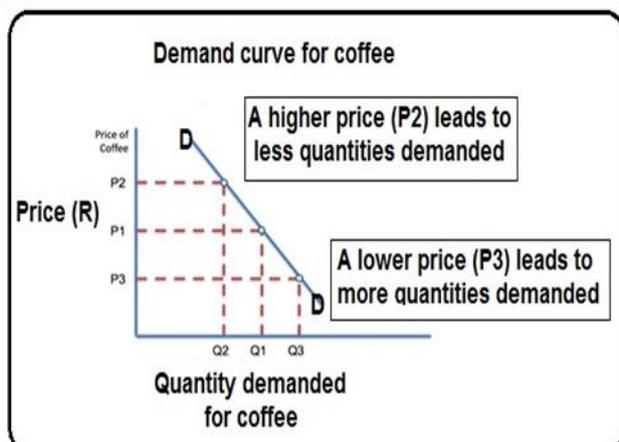
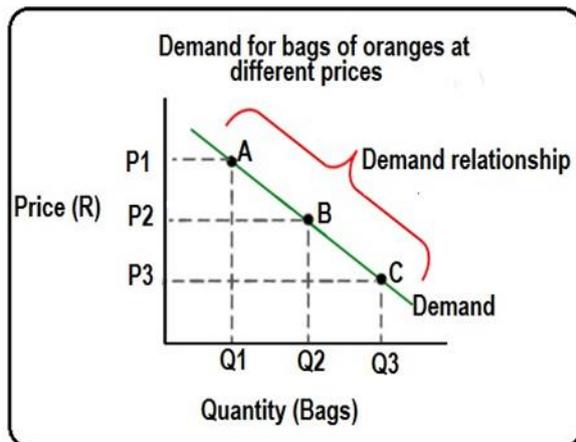
DETERMINATION OF PRICE USING DEMAND AND SUPPLY

Definition of demand: An economic concept that relates to a consumers' desire to purchase goods and services and willingness to pay a specify price in a given time.

• **Demand curve:** is a graph of the relationship between the price of a good and the quantity demanded.



A graph showing demand curve.



Demand curves

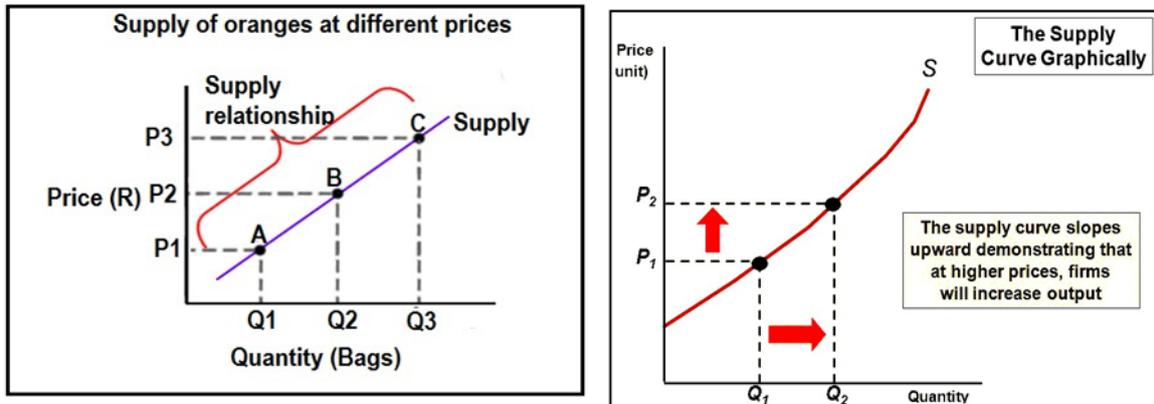
Interpretation of the demand curve

Points A B and C on the demand curve has direct correlation between quantity demanded (Q) and price (P). At point A, the quantity of oranges demanded will be Q1 and the corresponding price will be P1. The demand relationship illustrates the negative relationship between price and quantity demanded.

Factors influencing demand of a product.

- 1 **Price** An increase in the price of a product will lead to low demand for that product.
- 2 **Quality** of the product. High quality agricultural produce will lead to an increase in demand. Poor produce quality will lead to a decline in demand.
- 3 **Consumer taste and preferences.** When consumers prefer a product such as chicken to a competing product such as beef, the demand for chicken will increase.
- 4 **Fashion.** Changes in fashion can lead to a change in demand for certain products. For example, if the demand for Nguni cattle skins is in fashion, the demand for skins will increase.
- 5 **Compliments.** If the price of a produce that competes with other products is noticeably high, the demand for the product will be lower as consumers prefer to buy cheaper products.
- 6 **Festive seasons.** At certain times of the year such Christmas, the demand for meat and vegetables increase.
- 7 **The number of consumers.** Higher number of consumers is expected to lead to increase in demand for a product. Conversely, lower number of consumers will lead to a decrease in demand for a product.

Supply curves



Supply curves

Interpretation of the supply curve

A, B and C are points on the supply curve. Each point on the curve reflects a direct correlation between the quantity supplied (Q) and price (P). At point B, the quantity of goods supplied will be Q2 and the price at P2 and so on. If the offer of a product declines, the price rises because there is greater demand for it. If the offer increases, the price will drop as there is more of the product available to provide for the same demand. If the quantity declines, the price drops as well as producers try to encourage consumers to buy the product.

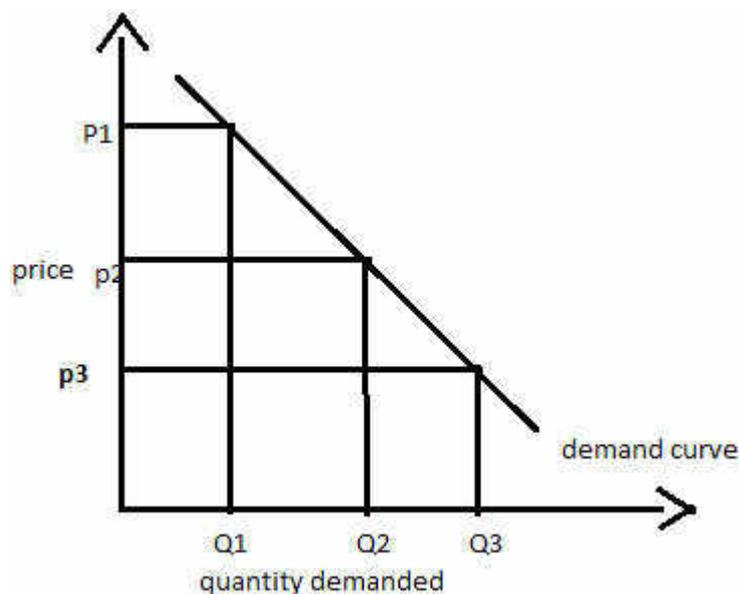
FACTORS AFFECTING SUPPLY OF A PRODUCT

- 1 **Price.** The higher the price of a produce, the higher the quantity sold by farmers because they get extra income from selling the produce.
- 2 **Production cost.** High cost of producing a product lead to farmers producing less of the particular product as they can only make a small profit. Low input cost will lead to high production of produce.
- 3 **Technological changes.** Improvements in technology in the production processes lead to increased production. For example, precision farming is an agricultural resource management strategy that collects, processes, and evaluates data and offers insight to help farmers increase soils quality and productivity.

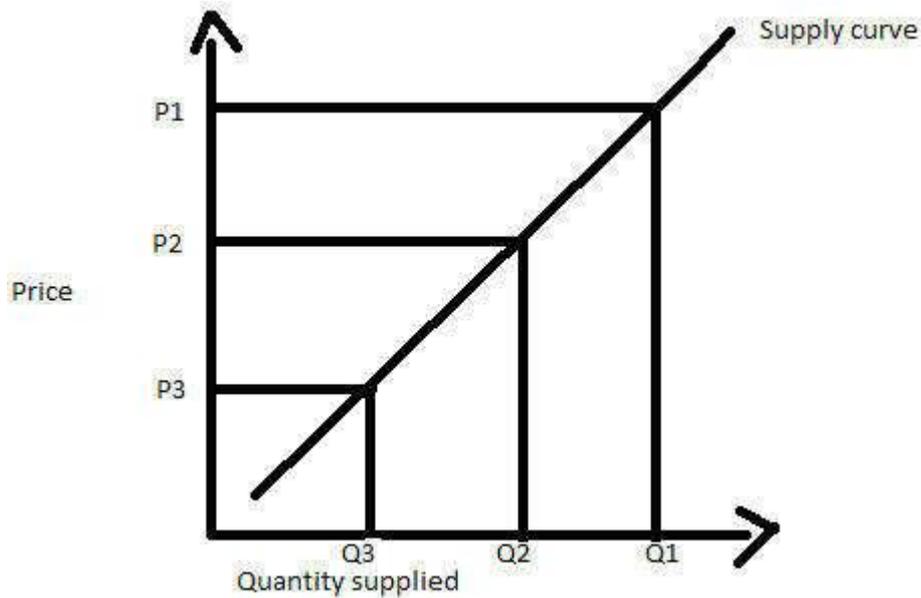
- 4 **Government subsidy and taxation.** Government subsidies such as paying part of the cost of fertilizer for farmers will reduce farmers production costs which in turn will lead to increased production.
- 5 **Political instability.** Conflicts can disrupt the supply and distribution of inputs and outputs and may cause displacement of farm labour.
- 6 **Number of suppliers and /producers.** Production of the same product, for example, maize by many farmers at the same time and to the same market will lead to high supplies of the product.
- 7 **Environmental conditions/climate.** Agriculture is highly dependent on the weather. Increase in temperature and carbon dioxide levels can increase some crop yields in some places. Very cold conditions may lead to lower supply of summer crops in South Africa.

THE LAWS OF DEMAND AND SUPPLY

The Law of Demand: The *Law of demand states that, all things being equal, price and quantity of a good are inversely related to each other.* In other words, when the price of a product such as apples increases, the demand for the same decreases.

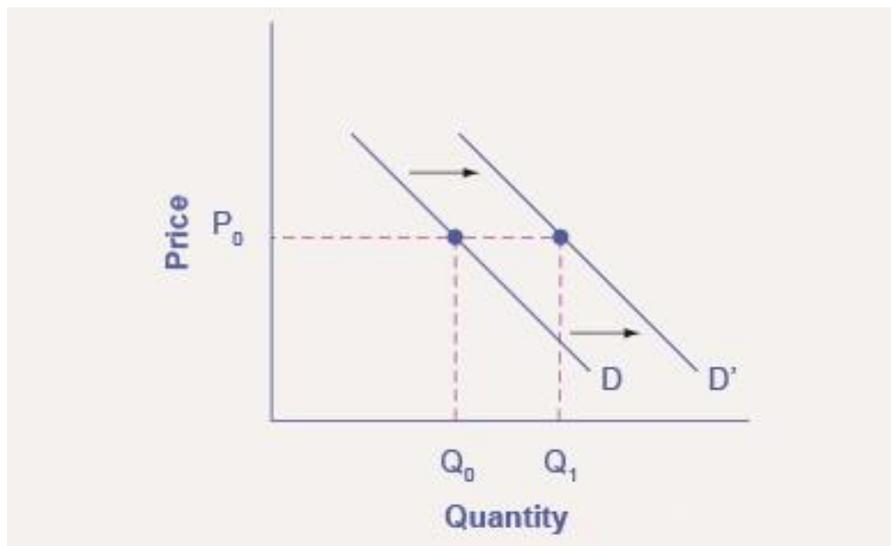


The Law of Supply: *The Law of supply states that all things being equal, the an increase in the price of goods or services results in an increase in their price. For example, if the price of potatoes increase, farmers will sell more of potatoes to increase their revenue/income.*



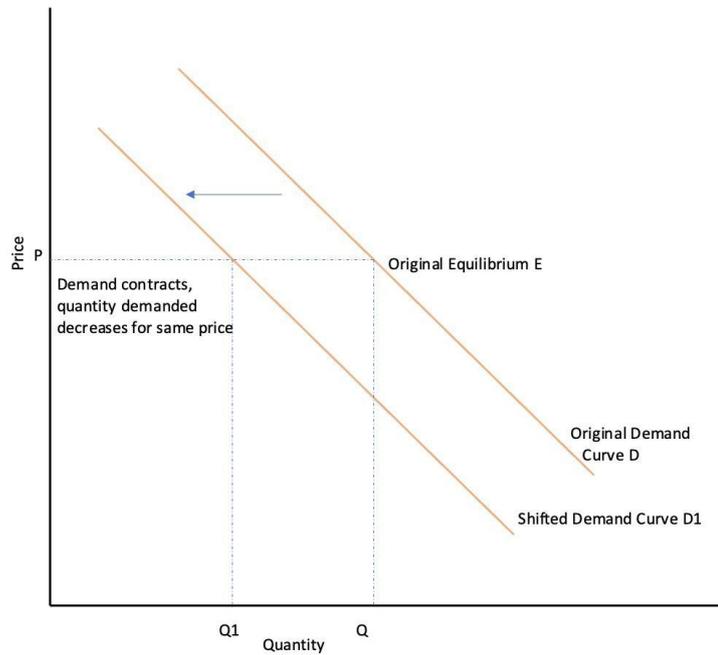
A graph illustrating the Law of Demand

Shift in Demand Curve:



A graph showing a shift in demand curve to the right.

If the quantity demanded at each price increase, the demand curve shifts to the right. If the quantity demand at each price level decreases, the demand curve will shift to the left.



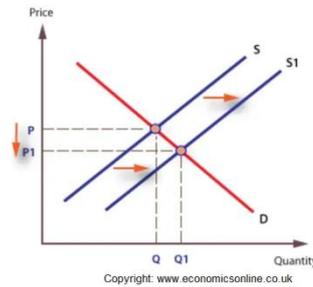
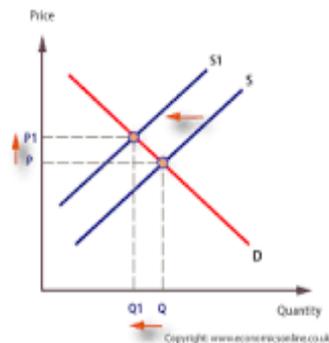
Graph showing a shift in demand curve to the left.

Causes of shift in demand curve

:

- Consumer income
- Consumer preferences
- Population size & composition
- Changes in prices of related goods

Shifts in Supply Curve



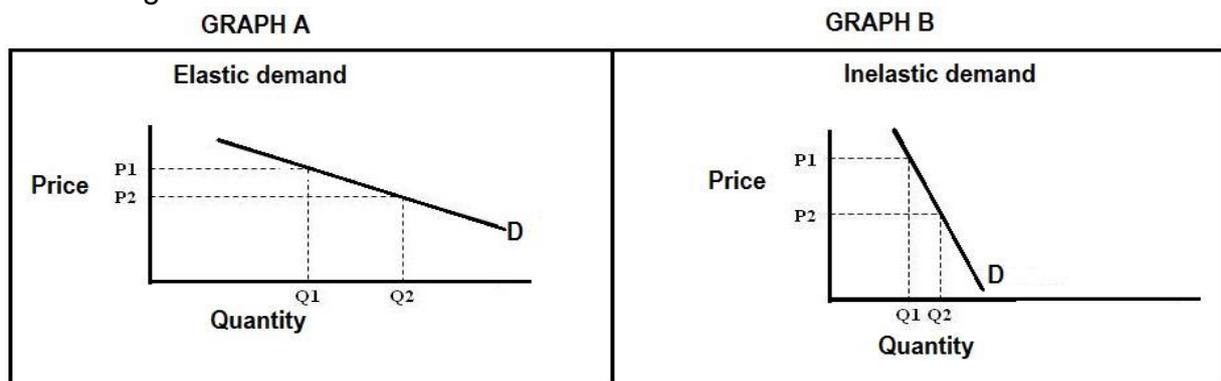
• Factors that influence shift in supply include

- Changes in production costs
- Improved technology, which makes production more efficient.
- Industry growth and shrinkage

PRICE ELASTICITY AND INELASTICITY OF DEMAND AND SUPPLY

Elasticity – This refers to the way price changes a demand or supply curve.

Price elasticity of Demand- This a measurement of the change in demand for a good or service in relation to a change in its price. It can also be described as the percentage change in quantity demanded divided by the percentage change in price. The degree of elasticity changes with the type of product in question. In some cases, a slight change in price will cause a big decrease in the quantity demanded. An example could be a chocolate bar or cavella shoes. The price of maize meal and most agricultural products is inelastic as people will still buy the product regardless of price change.



- A good is perfectly elastic if the price elasticity is infinite (if demand changes substantially even with minimal price change).
- If price elasticity is greater than 1, the good is elastic; if less than 1, it is inelastic.
- If a good's price elasticity is 0 (no amount of price change produces a change in demand), it is perfectly inelastic.
- If price elasticity is exactly 1 (price change leads to an equal percentage change in demand), it is known as unitary elasticity.
- The availability of a substitute for a product affects its elasticity. If there are no good substitutes and the product is necessary, demand won't change when the price goes up, making it inelastic.

Factors that affect the elasticity of demand

Nature of the product . Luxury items such as cheese show more elastic demand than necessities such as maize meal and cabbage.

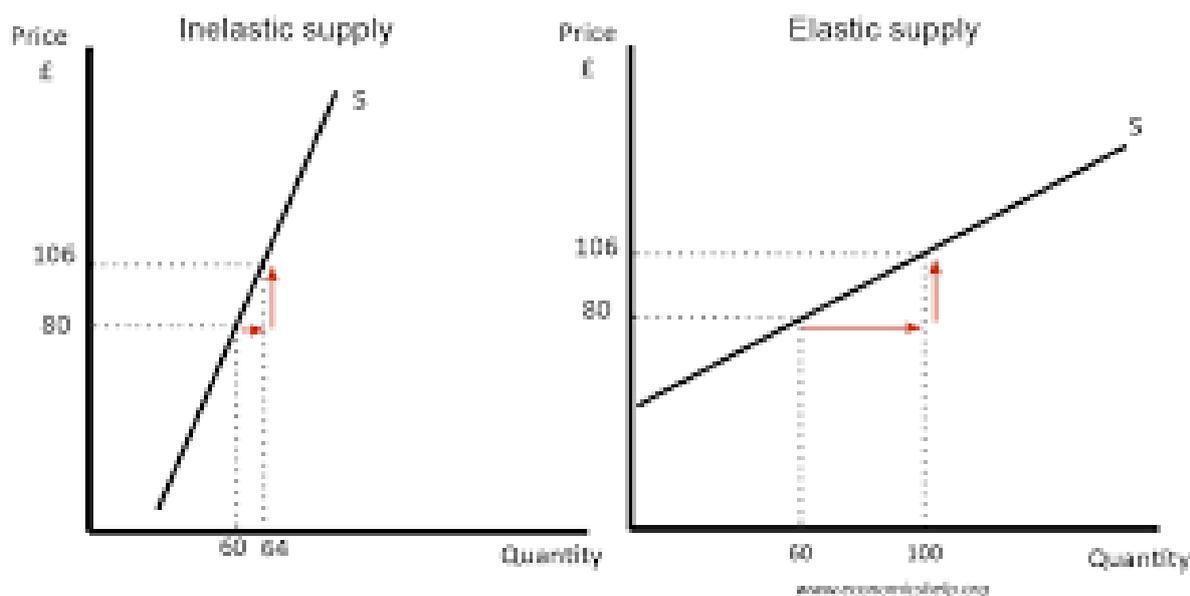
Availability of substitute products. Products having varieties of substitutes tend to have much more tended to be more elastic than those that do not have substitutes. For example, if the price of orange juice increase, many people will look for other types of drinks such as apple, mango, and pear drinks so the demand for orange juice is elastic.

Time period . Demands for products become more elastic with passage of time. For example, if the price for fertilizer is increased by say 40%, a farmer's demand might not change immediately but as time passed, the farmer might change for compost or farmyard manure.

Proportion of consumers budget spent on the item- Changes in prices will be more elastic if the product involved takes a chunk of the consumers income.

Price Elasticity of supply

This refers to the measure of how sensitive the quantity supplied of a good is to changes in price. According to basic economic theory, the supply of a good will increase when its price rises. Conversely, the supply of a product will decrease when its price decreases.

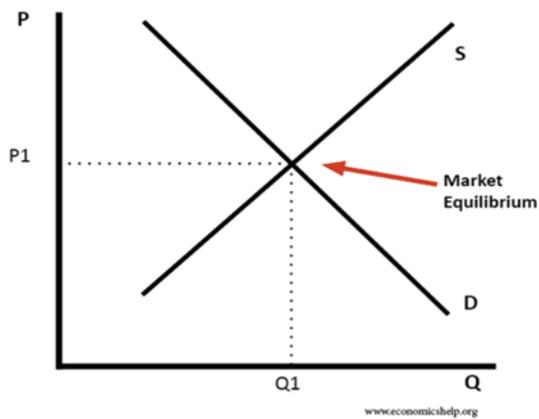


- When the change in supply is relatively less when compared to the change in price, we say that the commodity has a relatively-less elastic supply. In such a case, the price elasticity of supply assumes a value less than 1.
- When the change in supply is relatively more when compared to the change in price, we say that the commodity has a relatively greater-elastic supply. In such a case, the price elasticity of supply assumes a value greater than 1.
- For a commodity with a unit elasticity of supply, the change in quantity supplied of a commodity is exactly equal to the change in its price.

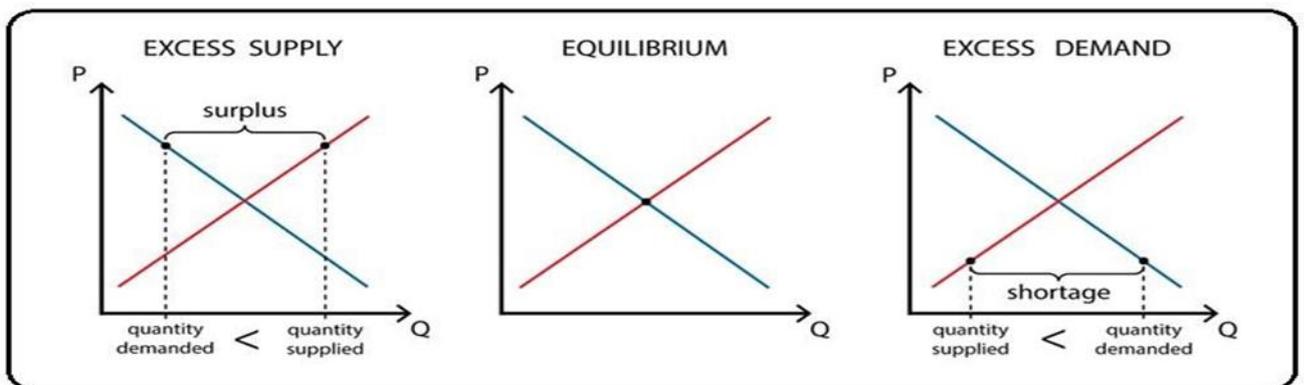
MARKETING EQUILIBRIUM

The market equilibrium is the point where the amount of product supplied by the producer is equal to the amount sought by buyers; supply is equal to demand.

Equilibrium price: the price at which the demand is equal to supply, and the market is cleared of all goods. If a market is in equilibrium, the price will not change unless an external factor changes the supply and demand, which results in a disruption of the equilibrium.



A graph showing market equilibrium.



Market equilibrium graphs showing surpluses and shortages.

Surplus occurs when production is above the equilibrium point. This often occurs if the floor price is set above equilibrium price.

Shortage occurs when production is below the equilibrium price. This normally occurs if the ceiling price is set below the equilibrium price.

AGRICULTURAL MARKETING SYSTEMS

Free marketing

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



A vendor selling farm produce

- **Advantages of a free market system**
 - Producers sell where they want.
 - Intermediaries are eliminated.
 - Producers can sell at own price and customers can bargain.
 - Entrepreneurship is rewarded.
 - Consumers are likely to benefit from better quality products.

Disadvantages of Free Marketing system

- There is risk for the producer.
- Consumers with more resources can get more of produce.
- Price fixing may occur.
- There is greater fluctuation of prices.

CHANNELS /OPTIONS OF A FREE MARKET SYSTEM/

Farm gate marketing/Bakkie sale /Truck sale

It is a form of marketing done by the farmer at the site of production. Examples include the sale of vegetables ,broilers and animals It is the most common form of marketing found amongst small producers in South Africa.

Advantages and disadvantages of farm gate marketing.

Advantages	Disadvantages
The producer may be able to obtain a market price for the product without incurring marketing costs	The farmer will have to accept the local price for the produce
Produce is sold at low prices	There will not necessarily be well located to reach customers
There is no transport cost involved	Buyers must be present at farm to purchase produce which necessitates good accessibility
Consumers get fresh produce with minimal loss of quality	There may be limited supply of produce

Fresh Produce market

Graded farm which is weighed is delivered to agents at the Municipal fresh produce markets. The farmer sends his produce to the agent at the market who negotiates for a good price on behalf of the farmer.

Advantages	Disadvantages
The market is able to sell produce in high volumes	Large volumes can be sold
Farmer can take advantage of above average prices in times of supply shortages.	Famer must have access to reliable market information
Produce is sent to agents at the municipal fresh produce markets	There can be price fluctuations in the market.
	Markets are often far from production centres
	Farmers pay agreed commission to market agents

Stock Sales/Livestock Auction Sale

Livestock are sold on auction near to a farm to the highest bidder. The auction is mostly run by livestock auction specialist from a private company registered with relevant authorities. Auction sales are held regularly, mostly monthly. The seller has to option to accept or reject the price offered by buyer.



Advantages	Disadvantages
The auctioneer advertises the event.	The seller may not be offered the expected price
Payment by the buyer is guaranteed	Lower prices than that of the market is a reality
Small scale farmers have access to these auctions	Small scale farmers may not be financially sound to transport their animals to the auction site

Direct /contract marketing

Farmer sells directly to the retailer/supermarket who in turn sells to others under a contract arrangement.



Advantages and disadvantages of direct sales

Advantages	Disadvantages
It is a cheap way of marketing produce because it saves time, money and labour	There should be always quality products
Many customers can be attracted very quickly	Customers do not know what they are buying
Marketing margins can be reduced because middlemen are cut out	The farmer must have enough produce to meet client's requirements
Results are obtained quickly	

Internet marketing

This is also known as web marketing or e-marketing .In this case, goods are sold on the internet through a computer or smart cell phone. It is a type of direct sales which includes marketing done via emails and wireless media.



Advantages	Disadvantages
Produce can reach global audience in a short space of time	It only helps consumes with internet/ smart phone network access
It has relatively low cost	Attracting customers may not be easy
Products can be delivered directly to the clients	Not all consumers shop online
Low capital-intensive business	The possibility of fraud/scamming is a big risk
Money can be transferred before goods are delivered	

AGRICULTURAL COOPERATIVES

A cooperative is a voluntary organisation formed by a group of people who have a common need that they want to address.



Types of Agricultural Cooperatives

- 1 Agricultural cooperatives sell products in with higher profits and provide for their members production requirements as cheaply as possible.
- 2 Commercial or consumer cooperatives. Their aim is supply the consumer requirements as cheaply as possible

Principles of Agricultural Cooperatives

- Democratic member control
- The highest authority of a co-operative is in the hands of members during a general meeting.
- Members of cooperatives have the democratic right to vote for their directors.
- In business operations of a co-operative, how much a member gets for bonuses depends on how much capital he or she has contributed

- Open and voluntary membership
- Anyone who fulfils the membership requirements is entitled to join the co-operative. Discrimination is not allowed in cooperatives .
- Autonomy and independence .A co-operative are an independent and autonomous body controlled by its own members and no outside influence or decision should affect the running of the co-operative.

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ACTIVITY 1

(30 Marks; 45 Minutes)



1.1 Define the term:

1.1.1 Demand (2)

1.1.2 Supply (2)

1.1.3 The Law of supply (2)

1.1.4 Market equilibrium (2)

1.1.5 The Law of Demand (2)

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

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

A A long- term plan

B Personal communication of information

C Exchange of goods for cash

D Convincing people to buy a product. (2)

1.2.2 An advantage of processing raw agricultural produce is:

A An increase in wages

B A decrease in job opportunities

C A decrease in the value of the product

D A way to overcome the supply of agricultural produce (2)

1.2.3 The Law of demand states that:

- A The higher the price, the higher the quantity of goods bought.
- B The higher the number of consumers, the lower the quality of good bought.
- C The lower the price, the higher the quantity of goods bought.
- D The lower the price, the lower the quantity of goods bought.

1.2.4 ... occurs at the point where the market supply and market demand and supply curves meet

- A Shortage
- B Market development
- C Surplus
- D Market equilibrium

1.2.5 One of the following factors influences the supply of a product. (2)

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

1.3 Change the underlined words in each of the following statements to make them TRUE . Write only the answer next to the to the question 1.3.1-1.3.6 in the ANSWER BOOK.

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

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

2.1.1 Define the concept *marketing*. (2)

2.1.2 Indicate for EACH of the descriptions below, (a) to (c), whether it refers to marketing or selling. Write down only the question number with the answer, e.g. (d) selling.

(a) Market survey conducted on 300 customers to determine their needs. (1)

(b) Focus on acquiring money to buy a container to sell the produce in the that season. (1)

(c) Focus on the number of bags of potatoes sold at a time (1)

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



2.2.1 Identify the marketing concept illustrated by demand **A** and **B** above. (1)

2.2.2 Give a reason for the answer to QUESTION 2.2.1. (1)

2.2.3 Explain the reason why consumers responded in such a way to the price change. (1)

Total 38 marks



ACTIVITY 2

(30 Marks; 45 Minutes)

2.1.1 Identify the functions of agricultural marketing above about each of the following:

(a) Products are taken from the farm to the market. (1)

(b) Products are kept on the farm before they are transported to the market. (1)

2.1.2 Give an economic term used to describe each of the following statements:

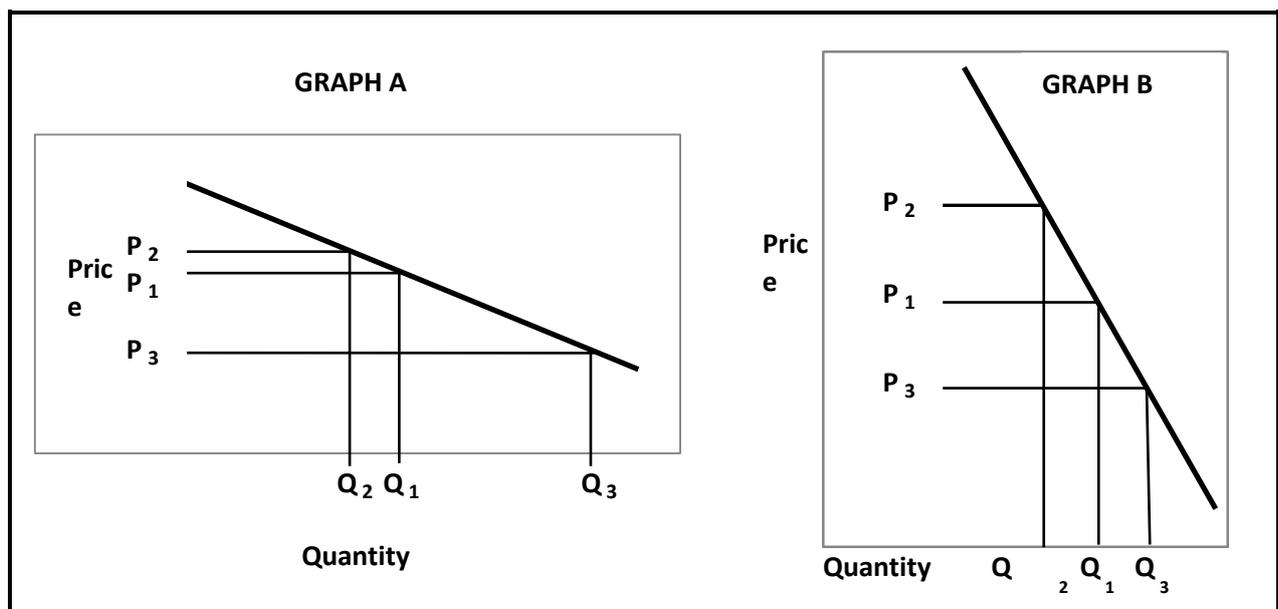
(a) Products are packed into boxes. (1)

(b) Products are kept in a cool place to give them a long shelf life. (1)

(c) A product is altered from its raw form. (1)

2.1.3 State TWO advantages of processing agricultural products. (2)

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



- 2.2.1 Identify the graph (A or B) that represents EACH of the following:
- (a) Price inelasticity of demand (1)
- (b) Price elasticity of demand (1)
- 2.2.2 Give a reason for your answers to QUESTION 2.2.1(a) and (b). (2)
- 2.2.3 State THREE other factors that may cause elasticity of demand. (3)

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

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

- 2.3.1 Use the data in the table above to draw a line graph comparing the quantities and the prices of the pockets of fruit. (6)
- 2.3.2 Deduce the relationship between the price and the quantity of fruit demanded. (2)
- 2.4 Define the following concepts
- 2.4.1 Price elasticity of demand (2)
- 2.4.2 Price Elasticity (2)
- 2.4.3 The Law of supply (2)
- 2.4.4 Market Equilibrium (2)
- 2.4.5 Hedging (2)
- 2.4.6 Free marketing (2)

Activity 3**(30 Marks; 45 Minutes)**

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

- (a) Products are placed in boxes. (1)
 - (b) Products are kept in cool place giving them a longer shelf-life (1)
 - (c) Changing a product from its raw form (1)
- 1.2 Give TWO advantages of the processing of agricultural products (2)

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

1.3.1 Give one marketing channel for EACH of the statements from the list below: Write only the channel next to the question numbers (.1.3.1 (a) to 1.3.1(c) in your answer book.

Internet marketing; stock sales; fresh produce market; farm gate marketing; contract marketing.

- (a) A farmer sells spinach direct from the farm. (1)
 - (b) Goat, sheep and cattle are sold to the highest bidder (1)
 - (c) Products are electronically advertised and sold (1)
 - (d) Mangoes and apples are delivered to markets immediately (1)
- 1.3.2 Name TWO disadvantages of a free marketing system (2)

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

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

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

2.1.2 Refer to the table above and justify with TWO reasons why the marketing system identified in QUESTION 2.1.1 was chosen. (2)

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

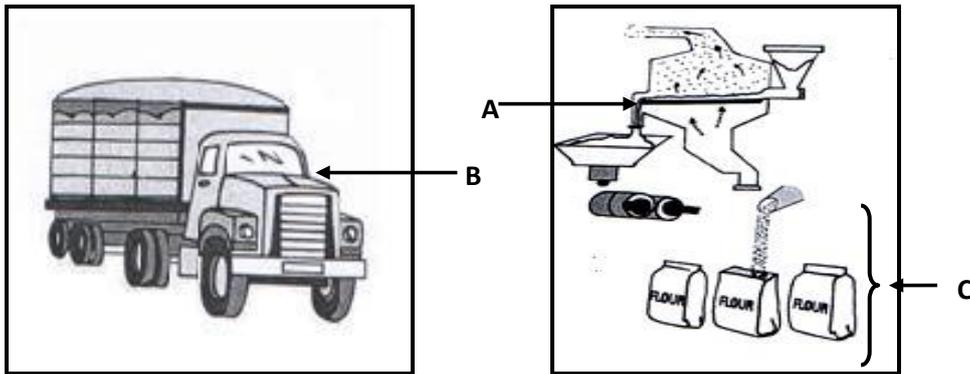
2.2.1 Identify the agricultural marketing system used by the farmers (1)

2.2.2 Indicate the role of the marketing system in QUESTION 2.2.1 (1)

2.2.3 Name TWO benefits of the marketing system in QUESTION 2.2.1 (2)

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

3.1 The pictures below illustrate the functions of marketing

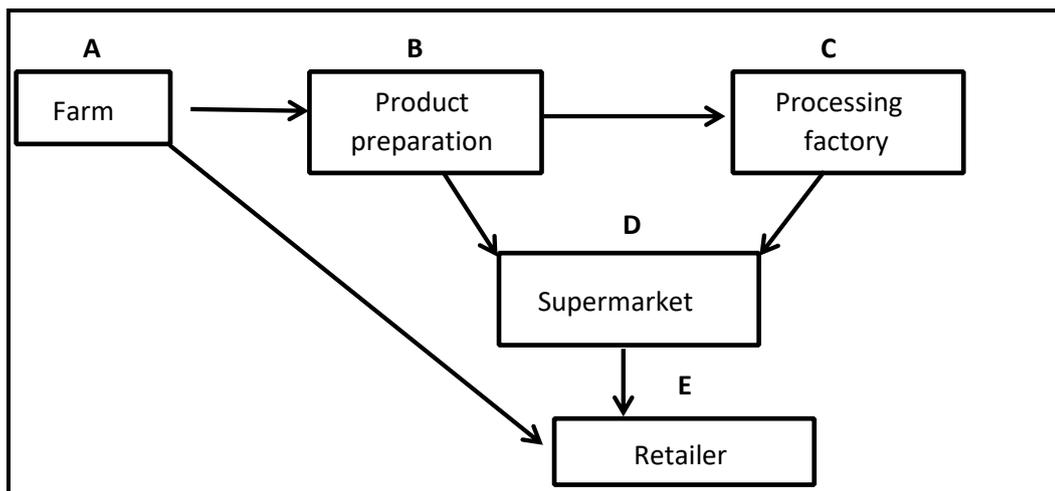


3.1.1 Identify the marketing functions illustrated in B and C (2)

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

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

3.2 The flow chart represents a marketing chain



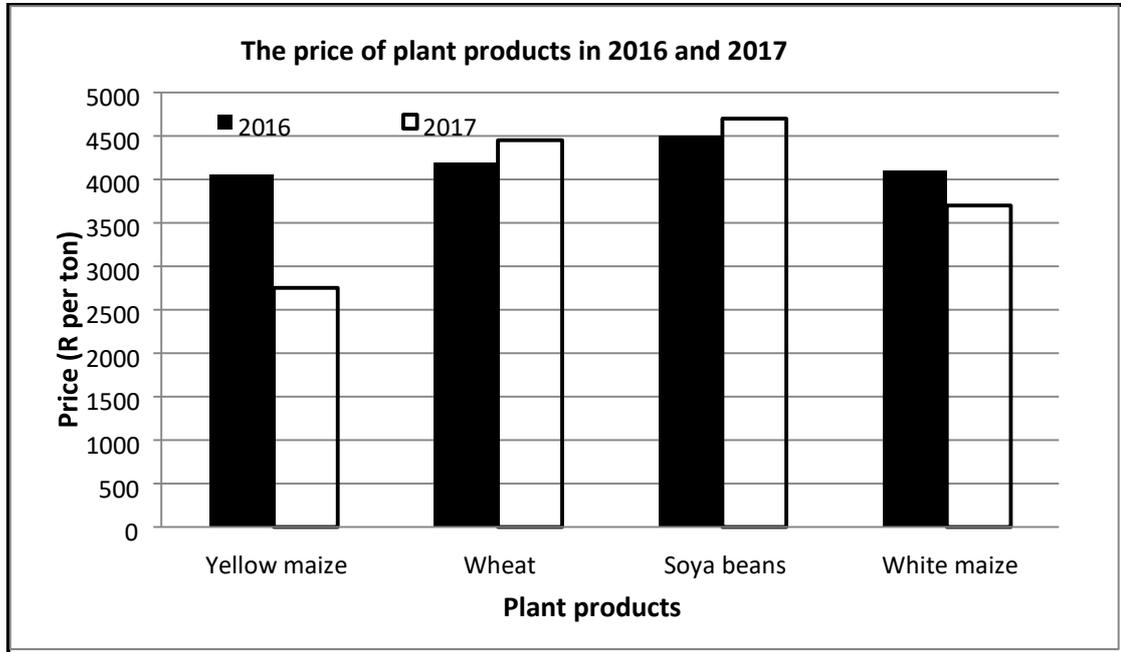
3.2.1 Identify the marketing chain illustrated above (1)

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

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

MEMO ACTIVITY 1

2.5 Bar graph



CRITERIA/RUBRIC/MARKING GUIDELINES

- Correct heading ✓
- X axis: Correctly calibrated with label (Plant products)
- Y axis: Correctly calibrated with label (Price) ✓
- Correct units (R per ton) ✓
- Bar graph ✓
- 80% plus accurate plotting of graph ✓ (6)

When the price of maize was decreasing from 2016 to 2017 ✓

- the price of red meat was increasing ✓

2.5.2 R2,50 ✓

(1)

MEMO ACTIVITY 1

1.1.1

(a) **Demand-** Refers to quantity of goods that consumers are willing and able to buy at different prices. ✓ (1)

(b) **Supply** Quantity of goods that producers are prepared to offer for sale at a particular price ✓ (1)

(c) **The Law of Supply** All other things being equal, an increase in price leads to an increase in the quantity of goods supplied./ Lowering prices lead to quantity of good sold being lowered. ✓ (1)

(d) **Market Equilibrium** A market situation where quantity of goods demanded is equal to quantity of supplied. ✓ (1)

(e) **The Law of demand** All other things being equal, an increase in price leads to lower quantity of goods being bought. ✓ (1)

1.2.1 A ✓ (1)

1.2.2 D ✓ (1)

1.2.3 C ✓ (1)

1.2.4 D ✓ (1)

1.2.5 C ✓ (1)

1.3.1 Cooperative marketing ✓ (1)

1.3.2 Barter ✓ (1)

1.3.3 Marketing ✓ (1)

1.3.4 Processing ✓ (1)

1.3.5 Buyer ✓ (1)

2.1.1 The process of planning and executing the conception, pricing, promotion ✓ and distribution of ideas, goods, and services to consumers ✓ (2)

2.1.2 (a)Marketing ✓ (1)

(b) Selling ✓ (1)

(c)Selling ✓ (1)

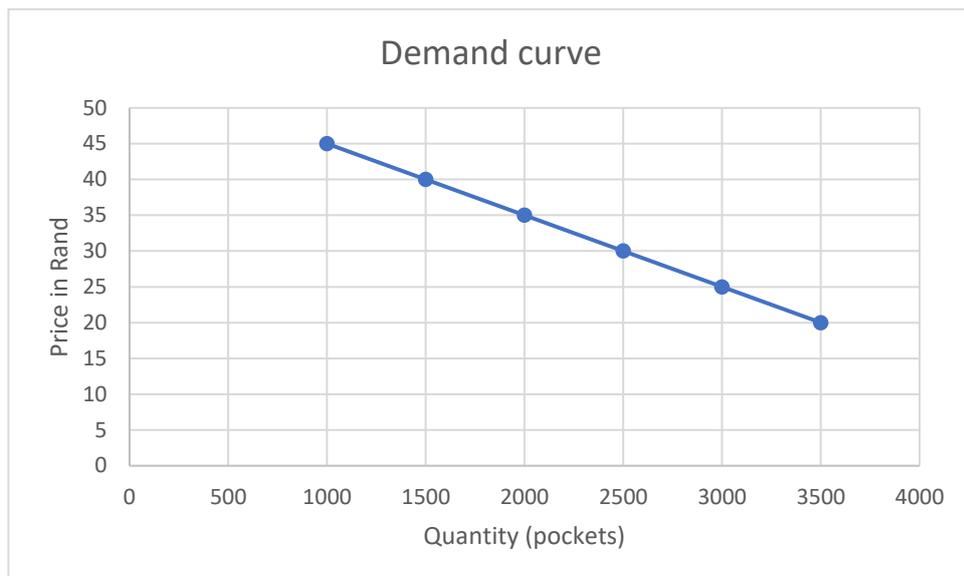
2.2.1 Price inelasticity of demand ✓ (1)

2.2.2 The demand changed slightly despite the huge change in price ✓ (1)

- 2.2.3 Maize meal is a necessity/staple food ✓ people will therefore buy maize meal even with a price increase ✓ (2)
- 2.2.4 Price ✓ (1)

MEMO ACTIVITY 2

- 2.1.1 (a) Distribution ✓ (1)
 (b) Storage ✓ (1)
- 2.1.2(a) Storage ✓ (1)
 (b) Processing ✓ (1)
- 2.2.1 Graph B ✓
 Graph A ✓
 In graph B, the change in price led to large quantity of product demanded. ✓
 In graph A, a change in price led to large quantity in goods demanded. ✓
- 2.2.2 Nature of product ✓ (1)
 Availability of substitutes ✓ (1)
 Time period ✓ (1)
 Consumer's budget ✓ (1)
 Proportion of income spent. ✓ (1)
- 2.4.1 Price elasticity of demand - a measurement of the change in demand for a good or service in relation to change in its price. ✓ (1)
- 2.4.2 It refers to quantity response to change in price. ✓ (1)
- 2.4.3 The Law of Supply- All other things being equal, the higher the price, the higher the quantity producers are willing to offer for sale. ✓ (1)
- 2.4.4 Market equilibrium – A market situation, where demand and supply are equal. ✓ (1)
- 2.4.5 Hedging – a market price risk management strategy where the market price is kept constant. ✓ (1)
- 2.4.6 Free market - a form of marketing where producers market their produce as they wish. ✓ (1)
- 2.3.1



Criteria for marking graph

- Title- demand curve ✓
 - Line graph ✓
 - Y axis correctly calibrated and labelled Price ✓
 - X axis correctly calibrated and labelled Quantity ✓
 - Units (R and pockets) ✓
 - Accuracy (80% points correctly plotted) ✓
- (6)

2.3.2 The quantity of fruits bought decreased as price increased ✓✓ (2)

MEMO ACTIVITY 3

1.1

- (a) Packaging ✓
- (b) Storage ✓
- (c) Processing ✓

1.2

- Available throughout the year. ✓
- Prevent the spoilage/wastage/perishability. ✓
- Can be transported to places where it is not produced ✓
- Storage period increases/longer shelf life ✓

- Improves the safety of products ✓
- More convenient/easier packaging/handling ✓
- Adds value/higher income/profit ✓
- Easier to transport than fresh products ✓
- Provides employment to many people ✓

(Any 2)

2.1

2.1.1 Free marketing ✓

2.1.2

- Sold vegetables door to door ✓
- Individuals responsible for own marketing ✓
- Selling at their own price ✓

2.1

2.2.1 Cooperative marketing ✓ ✓

2.2.2 Production/selling/marketing ✓ ✓

2.2.3

- Lower marketing costs/cost distribution ✓
- Requirements/services are supplied cheaper/bulk purchasing ✓
- More bargaining power ✓
- Access to funding/credit to producers ✓
- Higher prices are obtained ✓
- Elimination of the intermediaries ✓
- Potential for growth ✓
- Access to better infrastructure ✓
- Branding ✓

2.2.4

- Perishability/spoilage ✓
- Seasonal fluctuations in production ✓
- Lack of capital ✓
- Poor infrastructure ✓
- Wide distribution of production areas ✓
- Ineffective control over production ✓
- Risk/theft/accidents ✓
- Standardization ✓

- Large volume in relation to value/bulkiness ✓

3.1

3.1.1

B – Transportation ✓

C – Packaging ✓

3.1.2

- Provide information about the product/identification ✓
- Convenient for handling/containment ✓
- Biodegradable/recyclable ✓
- Free from chemicals/foreign objects ✓
- Protection against mechanical damage ✓

3.1.3

- Overcome over-supply of the product ✓
- Allows easier packaging and handling of product ✓
- Provide job opportunities ✓
- Ensures the availability of product throughout the year ✓
- Reduces spoilage/perishability/longer shelf life ✓
- Ensures food security ✓
- Improved food safety ✓
- Makes the products more appealing to the consumer ✓

3.2

3.2.1

3.2.1 Supply/Agri=business chain ✓

3.2.2

- Spoilage/perishability/lack of storage facilities ✓
- Accidents/theft ✓

3.2.3

- Improving access to market information ✓
- Providing storage facilities to prevent oversupply ✓
- Processing products close to where they are produced to reduce transportation costs ✓
- Use of refrigerated transport to prevent spoilage/perishability ✓
- Provision of access to finance ✓
- Grading/standardisation ✓
- Collective marketing ✓

BIBLIOGRAPHY

Department of Basic Education 2013-2021. The Curriculum Assessment and Policy Statement National and Provincial question papers.

Department of Basic Education 2021. The Curriculum Assessment and Policy Statement examination guideline. Pretoria: Government Printing Works.

Department of Education. Mind the Gap (Book 4) . Agricultural Sciences

Focus on Agricultural Sciences Grade 12 Maskew Miller Longman

[mutagens.001-e1572842674980-768x446.jpeg \(768x446\) \(geneticeeducation.co.in\)](#)

National Senior Certificate, 2016 – 2022 diagnostic reports. Pretoria: Government Printing Works.

Study & Master Agricultural Sciences. Grade 12. Cambridge University Press