CAMBRIDGE

# Study & Master

## Support Pack | Grade 12

CAPS

# Module 7 Units 1 – 2

# Agricultural Sciences

## Agricultural genetics

This support pack for the **Agricultural genetics** module in the **Agricultural Sciences Grade 12 CAPS curriculum** provides valuable revision activities. All activities have the answers provided. Learners can work through these individually at home or these could form the basis of a catch-up class or online lesson. You have permission to print or photocopy this document or distribute it electronically via email or WhatsApp.

**Cambridge University Press Africa** is a proudly South African publisher – we are providing this material in response to the need to support teachers and learners during the school shutdown and for the remainder of the 2020 school year.

For more information on our *Study & Master* CAPS-approved textbooks and valuable resource materials, visit ***www.cambridge.org***

**We are all in this together!**

# Module 7 – Agricultural genetics

## Unit 1 Genetic concepts

### Short questions

**1.** Various possible answers are provided for the following questions.Write only the correct letter (A–D) next to the question number.

**1.1** The passing on of characteristics from one generation to the next is .....… .

**A** homozygous
**B** heterozygous
**C** dominant
**D** heredity

**1.2** An example of a dominant homozygous characteristic for colour in chickens is .....… .

**A** cc
**B** Cc
**C** CC
**D** both A and B

**1.3** An example of a qualitative characteristic is .....… .

**A** milk production
**B** body size
**C** wool production
**D** horns or polled head

**1.4** An ..... individual has different alleles for a particular gene in each of the chromosomes.

**A** homozygous
**B** mitosis
**C** heterozygous
**D** meiosis

**1.5** The visible or observable characteristic produced by the individual's genotype.

**A** dominance allele
**B** genotype
**C** recessive allele
**D** phenotype

5 × 2 (10)

**2.** Match the description in column B with the word/term in column A.

| Column A | | Column B | |
|---|---|---|---|
| 2.1 | Genes | A | Only visible during cell division |
| 2.2 | Heredity | B | Only expressing heritable characteristics in the offspring when inherited by both parents |
| 2.3 | Chromosomes | C | Contain different information about the same characteristics |
| 2.4 | Alleles | D | The genetic composition of an individual |
| 2.5 | Genotype | E | The sequence of nucleotides |
| | | F | Cats always give birth to kittens, not puppies. |

5 × 2 (10)

**3.** Supply ONE word/term for each of the following descriptions. Write only the word/term next to the question number.

**3.1** Thread-like structures that are made up of long molecules of deoxyribose nucleic acid (DNA) that are wound up tightly

**3.2** The two possible forms of a gene

**3.3** Position of a gene on a chromosome

**3.4** The process by which gametes are produced in the sex organs

**3.5** A cell with half the number of chromosomes that are found in the rest of the body's cells $5 \times 2$ (10)

## Longer questions

**4.** Study the information on genetic crossings below and answer the questions that follow.
The allele for the characteristic black hair colour (B) is dominant over the allele for white hair (b). A black Aberdeen Angus bull with a bull calf with black hair is homozygous for black hair. The parent cow, a Charolais, has white hair.

**4.1** Use a genetic crossing diagram with labels to indicate the above situation down to $F_1$ generation (use the key B = black hair and b = white hair). (8)

**4.2** The bull calf mates with a white-haired Charolais heifer. Show the cross diagram from which we would be able to derive whether their offspring would be black like the Aberdeen Angus or white like the Charolais. (8)

**4.3** What is the probability (in percentage) that their offspring will be black like the Aberdeen Angus? (1)

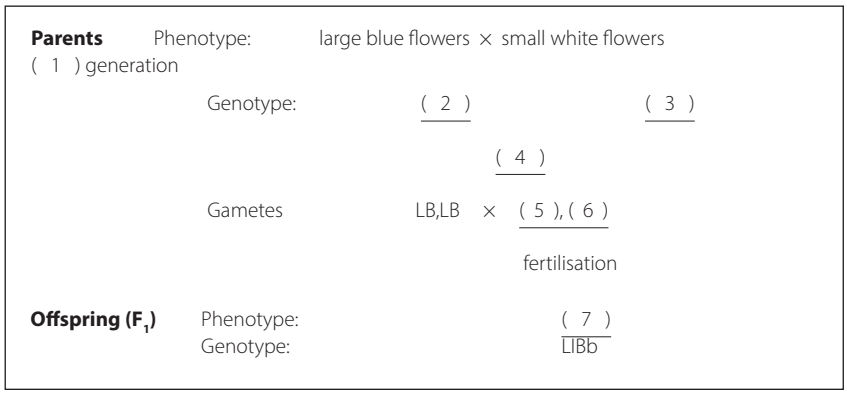
**4.4** What is the probability (in percentage) that their offspring will be white like the Charolais? (1)

**4.5** What percentage of the offspring will be homozygous? (1)

**4.6** What would the genotype of the bull calf be if the probability of having a white calf was 0%? Explain your answer. (2)

**5.** The following genetic diagram shows a crossing between two true breeding (homozygous) plants.

**5.1** Study the schematic illustration of a dihybrid cross and then redraw it, adding the missing words or symbols for numbers 1–7.




(7)

**5.2** Complete the following Punnett square that illustrates the genotypes found in the $F_2$ generation of crossed $F_1$ generations.

| Gametes | LB | Lb | lB | lb |
|---|---|---|---|---|
| LB | | | | |
| Lb | | | | |
| lB | | | | |
| lb | | | | |

(2)

**5.3** What is the ratio of the four phenotypes in the $F_2$ generation? (2)

# Unit 2 Patterns of inheritance, variation and mutation

## Short questions

**1.** Various possible answers are provided for the following questions. Write only the correct letter (A–D) next to the question number.

**1.1** An example of co-dominance is ..... .
- **A** blood groups in humans
- **B** pink flowers in the offspring
- **C** skin colour in cattle
- **D** single comb in chickens

**1.2** One of the following is not a type of gene mutation.
- **A** deletion
- **B** substitution
- **C** inversion
- **D** duplication

**1.3** An example of atavism is ..... .
- **A** red Friesland cattle that develop from black and white Friesland cattle after a few generations of black and white Friesland cattle
- **B** male calves in the $F_1$ generation
- **C** female calves in the $F_1$ generation
- **D** obtaining new cultivars

**1.4** An external cause of variation is ..... .
- **A** recombination of genes
- **B** crossing over of chromosomes
- **C** diseases
- **D** doubling

**1.5** The turning back and reunion of a chromosome is an example of ..... .
- **A** deletion
- **B** doubling
- **C** translation
- **D** inversion

5 × 2 (10)

**2.** Supply ONE word/term for each of the following descriptions. Write only the word/term next to the question number.

**2.1** The offspring have a mixture of the phenotypic characteristic of the two parents.

**2.2** There are over 100 different alleles controlling eye colour in the fruit fly Drosophila.

**2.3** Two or more genes, often in combination with environmental conditions, together influence the phenotype of an organism.

**2.4** An interaction between linked genes takes place when the action of one gene is modified or controlled by one or several other genes.

**2.5** A type of mutation in which an individual has more than two whole sets of paired chromosomes. 5 × 2 (10)

## Longer questions

**3.** The table below represents the offspring produced from a crossing of sunflower plants.

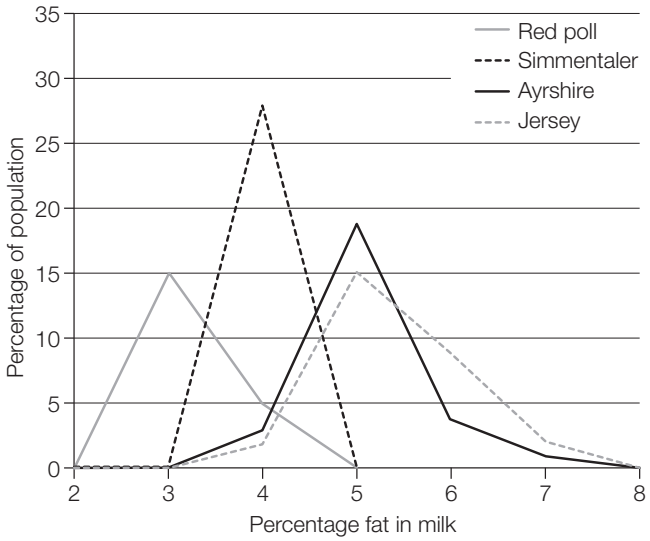
| | | | | | |
|---|---|---|---|---|---|
| Small | Large | Medium | Large | Small | Large |
| Large | Medium | Large | Small | Large | Small |
| Medium | Large | Small | Large | Small | Large |

**3.1** Describe the genetic phenomenon that is illustrated in the table. (1)

**3.2** Draw a simple table to compare the number of small, medium or large plants in the offspring with each other. (4)

**3.3** Briefly explain the main contribution of this phenomenon mentioned in question 3.1 for crop breeding. (1)

**4.** The graph below indicates the variation in the fat content of milk of individuals of the dairy breeds.




**4.1** Identify the breed with the lowest fat content. (1)
**4.2** Identify the breed with the smallest variation for fat content. (1)
**4.3** Identify the breed you would recommend in a cross-breeding programme to get the largest improvement of fat content in milk production. (1)
**4.4** Determine a reason for the bell-shaped variation curve in the graph. (1)

**5.** The sunflowers in field A and field B both come from the same seed with the same genes for height and were planted at the same time in different areas. The sunflowers in field A are tall while the sunflowers in field B are shorter.

**5.1** Suggest THREE external factors that might have contributed to the difference in the heights of the plants in the two fields. (3)
**5.2** Identify ONE dependent variable that the scientists were trying to investigate on these fields. (1)

# Memorandum

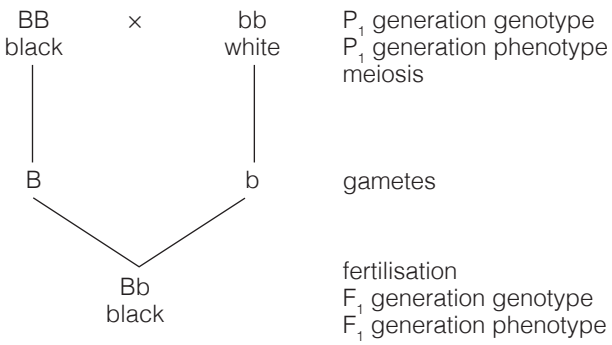
## Unit 1

### Short questions

**1.1** D **1.2** C **1.3** D **1.4** C **1.5** D (10)
**2.1** E **2.2** F **2.3** A **2.4** C **2.5** D (10)
**3.1** chromosomes **3.2** alleles **3.3** locus **3.4** meiosis **3.5** haploid (10)

### Longer questions

**4.1**




(8)

**4.2**

| | | |
|---|---|---|
| BB<br>black Aberdeen Angus bull calf | bb<br>white Charolais heifer | $F_2$ generation genotype<br>$F_2$ generation phenotype |
| | | meiosis |
| B or b | b | gametes |
| | | fertilisation |
| Bb<br>black Aberdeen Angus | bb<br>white Aberdeen Angus | $F_2$ generation genotype<br>$F_2$ generation phenotype |

OR

| gametes | b | b |
|---|---|---|
| B | Bb | Bb |
| b | bb | bb |

(8)

**4.3** 50% (1)

**4.4** 50% (1)

**4.5** 50% (1)

**4.6** BB. The offspring would all be Bb. The heterozygote will now show the white phenotypically because black is dominant over white. (2)

**5.1** 1 – $P_1$
2 – LLBB
3 – llbb
4 – meiosis
5 – lb
6 – lb
7 – large and blue (7)

**5.2**

| Gametes | LB | Lb | lB | lb |
|---|---|---|---|---|
| LB | LLBB | LLBb | LlBB | LlBb |
| Lb | LLbB | LLbb | LlBb | Llbb |
| lB | lLBB | lLBb | llBB | llBb |
| lb | lLBb | lLbb | llBb | llbb |

(2)

**5.3** large blue : large white : small blue : small white
9 : 3 : 3 : 1 (2)

# Unit 2

## Short questions

**1.1** A **1.2** D **1.3** A **1.4** C **1.5** D (10)

**2.1** Incomplete dominance **2.2** Multiple alleles **2.3** Polygenic inheritance
**2.4** Epistasis **2.5** Polyploidy (10)

## Longer questions

**3.1** There is a variation in the size of the plants. (1)

**3.2**

| Size of plants | Number of plants |
|---|---|
| Small<br>Medium<br>Large | 6<br>3<br>9 |

One mark for table format; three marks for information in table (4)

**3.3** Main contribution for crop breeding (any one):

- This allows plant breeders to select the plants with the desired characteristics in a plant breeding programme.
- It is possible to identify the differences of plants with regards to some desired characteristic. (1)

**4.1** Red poll (1)

**4.2** Red poll/Simmentaler (1)

**4.3** Jersey (1)

**4.4** Most of the animals are average with a certain percentage below and above average. (1)

**5.1** External factors contributing to height of plants (any three):

- Soil factors
- Temperature
- Light intensity
- Diseases and pests
- Moisture content (3)

**5.2** Height of the plants (1)