



UNIVERSITY OF ESWATINI

1<sup>ST</sup> SEM. 2019/2020

RE-SIT/SUPPLEMENTARY EXAMINATION PAPER

**PROGRAMMES:** B. Sc. ANIMAL SCIENCE  
B. Sc. ANIMAL SCIENCE (DAIRY OPTION)  
B. Sc. AGRICULTURAL EDUCATION  
B. Sc. AGRICULTURAL EXTENSION  
B. Sc. AGRONOMY  
B. Sc. HORTICULTURE

**COURSE CODE:** ASC 205

**TITLE OF PAPER:** PRINCIPLES OF GENETICS

**TIME ALLOWED:** TWO (2) HOURS

**INSTRUCTIONS:** ANSWER ANY FOUR (4) QUESTIONS

**SPECIAL REQUIREMENTS:** CALCULATORS

**DO NOT OPEN THIS PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE CHIEF INVIGILATOR**

**QUESTION 1**

- a. Gregor Johann Mendel is often referred to as the father of genetics, owing to his experiments on peas. Discuss five reasons why his experiments were successful. **(10 marks)**
- b. Describe the three key steps involved in the simplest of Mendel's experiments, based on a single pair of contrasting traits (monohybrid cross). **(9 marks)**
- c. The results of Mendel's monohybrid crosses led to three postulates, which are sometimes referred to as Mendel's first three principles. State them. **(6 marks)**

**QUESTION 2**

- a. Define recessive epistasis. **(2 marks)**
- b. In mice, albinism (white coat) is produced by a recessive gene *aa*. There is a different gene, **B**, which in the dominant state (*BB* and *Bb*) produces gray coat colour called agouti, and when recessive (*bb*) leads to black coat colour. The recessive gene for albinism (*aa*) is found to be epistatic to the gene for agouti (*BB* and *Bb*), and also to its recessive, homozygous allele (*bb*) for black. The presence of the dominant allele (*AA*) of the epistatic gene allows expression of gene **B** so that agouti (*BB* and *Bb*) and black (*bb*) coat colours can be produced.
- i. What are the genotypic and phenotypic ratios of a cross between an agouti mouse (*AABB*) and an albino mouse (*aabb*)? **(5 marks)**
- ii. Perform a cross of two agouti individuals whose genotype is *AaBb* and determine the genotypic and phenotypic ratios of the cross. **(10 marks)**
- c. Define the following terms and give examples:
- i. Penetrance **(2 marks)**
- ii. Genetic anticipation **(2 marks)**
- iii. Expressivity **(2 marks)**

iv. Incomplete dominance.

(2 marks)

### QUESTION 3

a. Consider three independently assorting gene pairs  $A/a$ ,  $B/b$  and  $C/c$ , where each demonstrates typical dominance ( $A_$ ,  $B_$ ,  $C_$ ), and recessiveness ( $aa$ ,  $bb$ ,  $cc$ ). What is the probability of obtaining an offspring that is  $AABbCc$  from parents that are  $AaBbCC$  and  $AABbCc$ ? (10 marks)

b. The wild-type (normal) fruit fly, *Drosophila melanogaster*, has straight wings and long bristles. Mutant strains have been isolated that have either curled wings or shaven bristles. The genes representing these two mutant traits are located on separate autosomes. Carefully examine the data for the five crosses in the table below.

i. For each mutation, determine whether it is dominant or recessive. In each case, identify which crosses support your answer. (5 marks)

ii. Define gene symbols, and for each cross, determine the genotypes of the parents. (10 marks)

Cross	Number of progeny			
	straight wings, long bristles	straight wings, short bristles	curled wings, long bristles	curled wing, short bristles
1. straight, short × straight, short	30	90	10	30
2. straight, long × straight, long	120	0	40	0
3. curled, long × straight, short	40	40	40	40
4. straight, short × straight, short	40	120	0	0
5. curled, short × straight, short	20	60	20	60

**QUESTION 4**

- a. What role do the following cellular components play in the storage, expression, or transmission of genetic information: chromatin, nucleolus, ribosome, mitochondrion, centriole, and centromere? (6 marks)
- b. How does telophase differ between plant and animal mitosis? (2 marks)
- c. Contrast spermatogenesis and oogenesis. (4 marks)
- d. Describe the role of meiosis in the life cycle of a vascular plant. (3 marks)
- e. Outline five differences between mitosis and meiosis. (10 marks)

**QUESTION 5**

- a. An insect species is discovered in which the heterogametic sex is unknown. An X-linked recessive mutation for reduced wing (*rw*) is discovered. Contrast the F<sub>1</sub> and F<sub>2</sub> generations from a cross between a female with reduced wings and a male with normal-sized wings, when:
- i. The female is the heterogametic sex. (10 marks)
- ii. The male is the heterogametic sex. (10 marks)
- iii. Is it possible to distinguish between the *Protenor* and *Lygaeus* modes of sex determination based on the outcome of these crosses? (5 marks)

**QUESTION 6**

*Drosophila* may be monosomic for chromosome 4 yet remain fertile. Contrast the F<sub>1</sub> and F<sub>2</sub> results of the following crosses involving the recessive chromosome 4 trait, bent bristles:

- a) Monosomic IV, bent bristles × diploid, normal bristles (13 marks)
- b) Monosomic IV, normal bristles × diploid, bent bristles. (12 marks)

**THE END!**