



SUPPLIMENTARY FINAL EXAMINATION 2010/2011

UNIVERSITY OF SWAZILAND

PROGRAMME: BSc. ANIMAL SCIENCE II,
BSc. ANIMAL SCIENCE DAIRY OPTION II,
BSC AGRONOMY II,
BSC HORTICULTURE II,
BSC AGRICULTURAL EDUCATION II

COURSE CODE: AS 204

TITLE OF PAPER: PRINCIPLES OF GENETICS

TIME ALLOWED: TWO (2) HOURS

INSTRUCTIONS: ANSWER QUESTION NUMBER 1 AND ANY OTHER 3 QUESTIONS

**THIS PAPER MAY NOT BE OPENED UNTIL THE CHIEF INVIGILATOR HAS GRANTED
PERMISSION**

1.

- a) Define the following genetic terms (12)
 - i). Dyad
 - ii). An allopolyploid
 - iii). cM
 - iv). Karyotype
 - v). Pleiotropy
 - vi). Chiasma
- b) What is the maximum possible recombination rate between any unlinked loci? (2)
- c) At what stage of mitosis do synapsed homologous chromosomes lie along the metaphase/equatorial plate? (2)
- d) Name the two unique events that occur in prophase I of meiosis but do not occur in prophase of mitosis. (2)
- e) What is the scientific term for the splitting of the cytoplasm? (2)
- f) The plant height trait in Mendel's studies is an example of complete dominance inheritance. What type of inheritance does the ABO blood group system exemplify? (2)
- g) If a genetic trait was inherited in simple dominant-recessive fashion and further, the inheritance of a dominant allele resulted in embryonic death, how many generations would it take to eliminate the lethal allele from the population? (2)
- h) Give the full name of the person referred to as "the father of modern genetics". (1)

2.

- a) Define recessive epistasis and clearly explain how the classic 9:3:4 ratio associated with this type of epistasis comes about. (10)
- b) When a male pig from a line of true breeding black, solid-hooved pigs (true breeding for both traits) was crossed to a female from a true breeding breed of red, cloven-hooved pigs (also true breeding for both traits), all the progeny produced from this first cross looked alike with regard to colour and hooves. These progeny were all mated to members of the same breed as their red, cloven-hooved mother pig. The offspring from this final cross were: 11 black, cloven-hooved; 11 black, solid-hooved; 11 red, cloven-hooved; and 11 red, solid-hooved.
 - i). For each of these two genes (coat colour and hoof type) determine which allele is the dominant one. Explain your reasoning. (4)
 - ii). What was the genotype of the progeny produced by the first mating in this problem? (2)
 - iii). A study of a human pedigree reveals an undesirable phenotype. Further examination of the pedigree reveals that a lot more males than females are affected. The appearance of the phenotype jumps a generation and is passed from normal females to male progeny. What type of inheritance is this? Draw a three generation pedigree to illustrate this type of inheritance. (8)

iv). Name a nitrogenous base that is present in DNA but absent in RNA (1).

3.

- a) The Rhesus positive (Rh⁺) allele is dominant to the Rhesus negative (Rh⁻) allele, while at another unlinked locus the A and B alleles exhibit codominance and are both dominant to the O allele. A woman who is phenotypically B^{Rh⁺} has a baby who is phenotypically AB^{Rh⁺}. Can a man who is AB^{Rh⁻} possibly have fathered this child? Explain how you arrive at your answer. (6)
- b) Briefly explain missense, silent and nonsense mutations. Which of these mutations do you believe are a serious threat to the well being or even survival of an organism in which they occur? Briefly explain your answer? (9)
- c) In a testcross of a female *Drosophila* heterozygous for three linked genes, the following progeny phenotypes were obtained:

ABd 413
AbD 12
Abd 19
ABD 0
abD 423
aBd 12
aBD 20
abd 1

Draw a map of the genes. (10)

4.

- a) List the three components of a nucleotide. (6)
- b) List two chemical differences between DNA and RNA. (4)
- c) Using an example explain how knowledge of genetics can be used to produce a named seedless fruit. (6)
- d) Mutations can either be gametic or somatic. In your opinion which of these would have more impact on a population. Briefly explain your answer. (4)
- e) Sugarcane (*Saccharum officinarum*) is grown from cuttings while pawpaws (*Carica papaya L.*) are grown from seeds. If planting material for each season was to be obtained from the previous crop, which of these two plants would show greater genetic variation from one generation to the next? Briefly explain your answer (5).

5.

- i). For each of the following fields give one example of how knowledge of genetics has been put to good use; crop production, animal production, human medicine, food industry and environmental protection. (10)
- ii). Why is it that in human societies marriage between close relatives is generally taboo and inbreeding of plants or animals is generally discouraged? (4)
- iii). List three key reasons why Mendel became a successful geneticist when other researchers before him had failed dismally. (3)

- iv). List two genetic diseases caused by genes located on a sex chromosome. (2)
- v). List in order of occurrence the first four stages of mitosis. (2)
- vi). Briefly discuss the following statement. "In some organisms, mitosis and not meiosis is involved in production of gametes" (4)