UNIVERSITY OF SWAZILAND

SUPPLEMENTARY EXAMINATION PAPER 2006

TITLE OF PAPER: GENETICS

COURSE CODE: B303

TIME ALLOWED: THREE HOURS

INSTRUCTIONS:
1. ANSWER ANY **FOUR** QUESTIONS
2. EACH QUESTION CARRIES TWENTY FIVE (25) MARKS
3. ILLUSTRATE YOUR ANSWERS WITH LARGE AND CLEARLY LABELLED DIAGRAMS WHERE APPROPRIATE
4. ALL WORKING MUST BE CLEARLY SHOWN

SPECIAL REQUIREMENTS:

a) CALCULATORS (CANDIDATES MAY BRING THEM)
b) STATISTICAL TABLES (BACK PAGE)

THIS PAPER IS NOT TO BE OPENED UNTIL PERMISSION HAS

BEEN GRANTED BY THE INVIGILATORS

QUESTION 1

a) In rabbits, coat colour is determined by a single gene C with three alleles as follows:

C^+ - Wild type (Agouti)
C^{ch}- Chinchila (A lighter gray)
C^h- Himalayan (White with black extremities)
c- albino.

The dominance relation is as follows:

$$C^+ > C^{ch} > C^h > c.$$

    i.   What type of inheritance is illustrated by this character? **[2 Marks]**

    ii.   State what phenotypes and in what proportions can be expected from the following crosses

Cross
C^+C^{ch} X C^+C^{ch}
C^+C^{ch} X $C^{ch}C^{ch}$
$C^{ch}C^h$ X $C^{ch}c$
C^+c X $C^{ch}C^h$

[4 Marks]

b) In cattle, the presence of horns is determined a single gene with two alleles as follows:

P- polled (horns absent)   p- horned

Predict what progeny and in what proportions can be expected in the following crosses

Cross	Sire	Dam
i.	PP	PP
ii.	PP	Pp
iii.	Pp	Pp
iv.	Pp	pp
v.	PP	pp

[10 Marks]

c) In some cattle, the gene for black colour is dominant over the gene for red colour (B- Black; b- red). A black, polled bull is crossed to a red, horned cow over a number of years to produce an F_1.

    i. State the genotypes of the bull and the cow.   **[2 Marks]**
    ii. State the genotype of the F_1.   **[1 Mark]**
    iii. If the F_1 were allowed to intercross, state what genotypes and in what proportions could be expected among the F_2. Indicate the phenotypes associated with each genotype.   **[6 Marks]**

[TOTAL 25 MARKS]

QUESTION 2

a. Explain what is meant by aneuploidy.   **[2 Marks]**
b. With the aid of diagrams, explain how aneuploids might arise.   **[5 Marks]**
c. Name four conditions associated with aneuploidy and explain their consequences in diploid and polyploidy organisms.   **[8 Marks]**
d. Explain how polyploidy has been exploited in agriculture using specific examples to illustrate your answer.   **[5 Marks]**
e. Explain the meaning of the following terms:

    i. Autopolyploidy Vs Allopolyploidy
    ii. Homelogous Vs homeologous pairing

[5 Marks]

[TOTAL 25 MARKS]

QUESTION 3

a. Describe the mechanism of sex determination in the following organisms:

    i. Honeybees
    ii. Snakes
    iii. Grasshoppers
    iv. Human beings

[12 Marks]

b. A rooster that is heterozygous for a sex-linked recessive lethal which results in death of affected individuals before hatching. What ratio of males to females can be expected if this rooster is mated with a normal hen? Show how you arrive at your answer.   [3 Marks]

c. In *Drosophila,* eye colour is controlled by an X-linked gene R in which the dominant allele results in red eyes whilst the recessive allele results in white eyes. A red eyed male is crossed to a white eyed female.

   i.   Explain what phenotypes, and in what proportions, may be expected amongst the progeny.   [5 Marks]
   ii.   If the reciprocal cross is carried out, what phenotypes, and in what proportions may arise among the progeny.   [5 Marks]

[TOTAL 25 MARKS]

QUESTION 4

a. In chickens, the shape of the comb is determined by two genes A and B as follows:

R on its own gives a Rose comb
P on its own gives a Pea comb
R and P together result in a walnut comb.
Double homozygotes have single combs.

A breeder crosses a true breeding Rose comb hen to a true breeding pea comb cock.

   i.   State the genotypes of the hen and the cock.   [2 Marks]
   ii.   Predict the genotype and phenotype of the F_1 in this cross. [2 Marks]
   iii. State what phenotypes and in what proportions can be expected in the F_2 of this cross.   [6 Marks]

b. Flower position, stem length, and seed shape were three characters that Mendel studied. Each is controlled by an independently assorting gene and has dominant and recessive expression as follows:

Character	Dominant	Recessive
Flower position	Axial (*A*)	Terminal (*a*)
Stem length	Tall (*L*)	Dwarf (*l*)
Seed shape	Round (*R*)	Wrinkled (*r*)

If a plant that is heterozygous for all three characters were allowed to self-fertilize, what proportion of the offspring would be expected to be as follows?

    i.   Homozygous for the three dominant traits
    ii.   Homozygous for the three recessive traits
   iii. Heterozygous
   iv. Homozygous for axial and tall, heterozygous for seed shape
      [8 Marks]

c. Give examples of traits under the following types of genetic control:

    i.   Multiple allelism
    ii.   Multiple genes
   iii. Incomplete dominance
   iv. Codominance   **[7 Marks]**

[TOTAL 25 MARKS]

QUESTION 5

a) Explain what is meant by quantitative inheritance.   **[2 Marks]**
b) In a certain population of plants, height is controlled by five genes A,B,C, D and E. Each dominant allele adds 3 units to a base height of 30 units. A geneticist crosses two plants of genotypes AABBccddee and aabbCCDDEE.

    i.   State the height of the two parents.   **[3 Marks]**
    ii.   Predict the genotype and phenotype of the F1.   **[3 Marks]**
   iii. What phenotypes and in what proportions can be expected in the F2 of this cross?   **[8 Marks]**

c) Explain what is meant by heritability including an account of its application.
    [5 Marks]
d) Distinguish between narrow and broad sense heritability.   **[4 Marks]**

[TOTAL 25 MARKS]

QUESTION 6

Discuss the experimental evidence that led to the conclusion that DNA is the genetic material.   **[TOTAL 25 MARKS]**