1ST SEM. 2009/2010

UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER: DECEMBER 2009

PROGRAMMES:	**(1) BSC AGRICULTURAL EDUCATION II** **(2) AGRONOMY II** **(3) ANIMAL SCIENCE II** **(4) HORTICULTURE II**
COURSE CODE:	**AS204**
TITLE OF OF PAPER:	**PRINCIPLES OF GENETICS**
TIME ALLOWED:	**TWO (2) HOURS**
INSTRUCTIONS:	**YOU MUST ANSWER QUESTION 1 AND ANY OTHER 3 QUESTIONS.** **ALL WORKING MUST BE CLEARLY SHOWN**
REQUIREMENTS:	**CANDIDATES MAY BRING CALCULATORS**

THIS PAPER SHOULD NOT BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE CHIEF INVIGILATOR

PTO

Question 1 (COMPULSORY)

(a) List the three subdivisions of genetics and summarize what each covers. (3 marks)

(b) Explain the chromosome theory of inheritance. (5 marks)

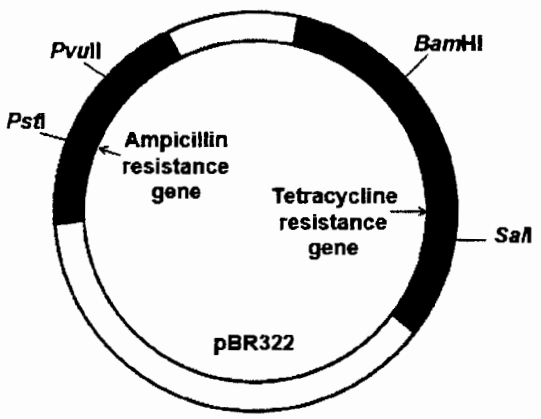
(c) Assuming that genes assort independently, state the phenotypic ratios produced by the following crosses:
(i) a selfed monohybrid, (1 mark)
(ii) a test-crossed monohybrid, (1 mark)
(iii) a selfed dihybrid, (1 mark)
(iv) a test-crossed dihybrid. (1 mark)

(d) Pure breeding black rabbit was crossed with a pure breeding white rabbit. All F_1 progeny were black. Selfing F_1 produced 11 black and 4 white F_2 rabbits.
(i) Explain the term pure breeding. (2 marks)
(ii) Explain the mode of inheritance shown here. (2 marks)
(ii) Give the proportion of white rabbits (if any) obtainable from test-crossing an F_1 rabbit. (2 marks)

(e) A cell of genotype *A/a*; *B/b*; *C/c* has all the genes on separate chromosome pairs. After mitosis, give the genotypes of the daughter cells. (1 mark)

(f) A herd of pure breeding black polled (hornless) bulls was allowed to mate with a herd of pure breeding horned brown cows. All F_1 calves were black and hornless. One F_1 bull and a fellow F_1 cow were crossed to get an F_2 calf.
(i) Explain the genetic relationships between the two fur colour phenotypes as well as polled and horned phenotypes. (2 marks)
(ii) Calculate the probability that the F_2 calf will have either horns or brown fur. (5 marks)
(ii) Suppose the above F_1 pair was allowed to produce another calf, calculate the probability that the two calves will be phenotypically identical with regard to skin colour. (5 marks)

(g) An ampicillin-resistant, tetracycline-resistant plasmid, **pBR322**, is cleaved with *Pst*I, which cleaves within the ampicillin gene. The cut plasmid is ligated with *Pst*I-digested *Drosophila* DNA to prepare a genomic library and a mixture is used to transform *E.coli* K12 competent cells.



(i) State, with reasons, the antibiotic that should be added to the medium to select bacterial cells that have incorporated a plasmid. (4 marks)
(ii) Explain the growth pattern that should be selected to obtain plasmids containing *Drosophila* DNA inserts. (3 marks)
(iii) Explain the presence of colonies that are resistant to both antibiotics. (2 marks)
[Total 40 marks]

Question 2

(a) Explain the following terms:
(i) recessive epistasis, (1 mark)
(ii) expressivity, (1 mark)
(iii) penetrance, (1 mark)
(iv) incomplete dominance, (1 mark)
(v) phenocopy, (1 mark)
(vi) pleiotropy, (1 mark)
(vii) selfing. (1 mark)

(b) A female animal with genotype *M/m; N/n* is crossed with a double-recessive male *m/m; n/n*. Their progeny include 442 *M/m; N/n*, 458 *m/m; n/n*, 46 *M/m; n/n*, and 54 *m/m; N/n*. Calculate the genetic distance between the *m* and *n* loci and draw the genetic map. (6 marks)

(c) Using examples, explain why expression of some X-linked genes in female mammals result in mosaic phenotypes. (7 marks)
[Total 20 marks]

Question 3

(a) Sketch the following chromosomes:
(i) telocentric, (2 marks)
(ii) acrocentric, (2 marks)
(iii) metacentric. (2 marks)

(b) Briefly explain the following as they apply to chromosomal mutations:
(i) paracentric inversion, (2 marks)
(ii) pericentric inversion, (2 marks)
(iiii) reciprocal translocation. (2 marks)

(c) In a haploid organism, the *A* and *B* loci are 8 m.u. apart. From a cross: *Ab* x *aB*, give the proportion of each of the following progeny classes:
(i) *AB*, (2 marks)
(ii) *ab*, (2 marks)
(iii) *Ab*, (2 marks)
(iv) all recombinants. (2 marks)
[Total 20 marks]

Question 4

In one experiment, pure breeding black Labrador male dog was crossed with a pure breeding brown Labrador female dog. The resulting F_1 had all black puppies. Selfing F_1 resulted in a *black: brown* dog distribution of 3:1. In another experiment, a man allowed his pure breeding black Labrador female dog to mate with a friend's pure breeding albino male dog resulting in all black puppies in the F_1. The F_1 was allowed to intercross resulting in F_2 progeny with a total of 48 puppies as follows: 26 Black, 10 brown and 12 albino.

(a) Explain these results. (4 marks)

(b) Using defined symbols of your choice, state the genotypes of Parents, F_1 progeny and albino F_2 progeny in the second experiment. (10 marks)

(c) One F_2 albino female dog was crossed with an F_2 black male. The resulting F_3 progeny had the following distribution: 50% albino: 37.5% Black: 12.5% brown. Investigate the genotypes of the F_2 progeny used in the cross and give the genotypes of all the F_3 progeny. (6 marks)

[Total 20 marks]

Question 5

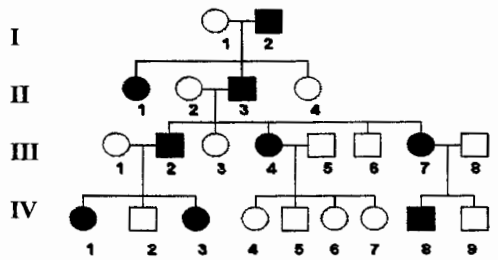
(a) Explain the following:
(i) Hardy-Weinberg equilibrium law, (1 mark)
(ii) polygenic inheritance, (1 mark)
(iii) broad-sense heritability, (2 marks)
(iv) narrow sense heritability. (2 marks)

(b) The following variances were calculated for the two traits in a herd of bufallos.

Trait	S_p^2	S_g^2	S_e^2
Back fat	30.6	12.2	8.44
Body length	52.4	26.4	11.7

Calculate the broad-sense heritability and narrow-sense-heritability for each trait in this herd. (8 marks)

(c) Study the following pedigree and deduce the mode of inheritance. (6 marks)



[Total 20 marks]

END OF EXAM