1ST SEM. 2006/2007

UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER

PROGRAMME:	**DIPLOMA IN AGRICULTURE AND DIPLOMA IN AGRICULTURE EDUCATION YEAR II**
COURSE CODE:	**APH 202**
TITLE 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:	**CALCULATOR AND STATISTICAL TABLES**

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

QUESTION 1 (COMPULSORY)

a) When a plant of a genotype PpRr is self-fertilized and produces 1600 seeds, how many of these seeds will produce plants of similar genotype to that of their parent (PpRr)? Show all working. **(10 Marks)**

b) Explain what is meant by the following:
   i. Blending theory of inheritance
   ii. Monohybrid cross
   iii. Parallel behaviour of genes and chromosomes
   iv. Environmental sex determination
   v. Sex-linkage **(10 Marks)**

c) Distinguish between the following:
   i. Concordance and discordance
   ii. Penetrance and expressivity
   iii. Sex-limited and sex-influenced traits **(12 Marks)**

d) In four-o'clock plants, the allele for red flower colour has an effect that is incompletely dominant over the effect of white colour allele. Using clearly defined symbols of your choice, determine what ratios of flower colour would you expect among the offspring of the following crosses:
   i. Red x red
   ii. Red x pink
   iii. White x pink
   iv. Pink x pink? **(8 Marks)**

QUESTION 2

In cattle, the effect of the allele producing red coat colour (*R*) is incompletely dominant over the effect of the allele producing white coat colour (*r*), the heterozygote being roan-coloured (*Rr*). On the other hand, the effects of alleles for the

absence of horns show complete dominance; *HH* and *Hh* are hornless or 'polled', and *hh* is horned. Assuming that these two gene pairs assort independently:

a) What would be the genotype and phenotype of F_1 derived from mating *RRHH* x *rrhh*? **(4 Marks)**

b) What would be the phenotypes and their proportions in an F_2 derived from crossing F_1 x F_1? **(8 Marks)**

c) What would be the phenotypic proportions among the progeny derived from crossing F_1 individuals to the original white horned stock? **(8 Marks)**

QUESTION 3

a) State Mendel's laws of segregation and independent assortment. **(5 Marks)**

b) Assuming segregation and independent assortment, give the possible number and kinds of gametes from the following genotypes:

i. *AAbb*,
ii. *AaBb*,
iii. *Aabb*,
iv. *AABbCc*,
v. *AaBbCc*. **(10 Marks)**

c) Giving examples, explain dominant and recessive epistasis. **(5 Marks)**

QUESTION 4

a) A common kind of red-green colour blindness in humans is caused by the presence of sex-linked recessive gene *c*, whose normal allele is c^+. A normal woman whose father was colourblind marries a colourblind man. They produce a son and a daughter.

i. What is the probability that the son is colourblind? **(2 marks)**
ii. What is the probability that the daughter is colourblind? **(2 Marks)**

iii. Show the expected phenotypes and their proportions in the reciprocal cross. **(4 Marks)**

b) In garden peas, two gene pairs *Ss* and *Yy*, with *S* and *Y* being dominant over s and *y*, respectively, are assumed to be segregating independently. A cross between two heterozygotes *SsYy* x *SsYy* would be expected to produce four phenotypic classes in the ratio 9 *S_Y_* : 3 *S_yy* : 3 *ssY_* : 1 *ssyy*. When this cross was carried out, the observed numbers were 1080 *S_Y_* : 210 *S_yy* : 200 *ssY_* : 110 *ssyy*. Test the hypothesis that the observed classes are in the ratio 9:3:3:1. (Use $\alpha = 0.05$). **(12 Marks)**

QUESTION 5

a) What is the significance of twin studies in genetic inheritance analyses? **(5 Marks)**

b) Discuss the effects of external and internal environment on gene expression. **(10 Marks)**

c) Explain why x-linked recessive abnormalities are more common in men than in women. **(3 Marks)**

d) A child of blood group *O* was born to parents both of blood group *B*. Give the most probable genotypes of these parents. **(2 Marks)**

Percentage Points of the Chi-Square Distribution

Probability of a larger value of χ^2								
0.99	0.95	0.90	0.75	0.50	0.25	0.10	0.05	0.01
0.000	0.000	0.016	0.102	0.455	1.32	2.71	3.84	6.63
0.020	0.103	0.211	0.575	1.386	2.77	4.60	5.99	9.21
0.115	0.352	0.584	1.213	2.366	4.11	6.25	7.81	11.34
0.297	0.711	1.064	1.923	3.357	5.38	7.78	9.49	13.28
0.554	1.145	1.610	2.675	4.351	6.63	9.24	11.07	15.09
0.872	1.635	2.204	3.455	5.348	7.84	10.64	12.59	16.81
1.239	2.167	2.833	4.255	6.346	9.04	12.02	14.07	18.47
1.646	2.733	3.490	5.017	7.344	10.22	13.36	15.51	20.09
2.088	3.325	4.168	5.899	8.343	11.39	14.68	16.92	21.67
2.568	3.940	4.865	6.737	9.342	12.55	15.99	18.31	23.21
3.053	4.575	5.578	7.584	10.341	13.70	17.27	19.67	24.72
3.571	5.226	6.304	8.438	11.340	14.84	18.55	21.03	26.22
4.107	5.892	7.042	9.299	12.340	15.98	19.81	22.36	27.69
4.660	6.571	7.790	10.165	13.339	17.12	21.06	23.68	29.14
5.229	7.261	8.547	11.036	14.339	18.25	22.31	25.00	30.58
5.812	7.962	9.312	11.912	15.338	19.37	23.54	26.30	32.00
6.408	8.672	10.085	12.792	16.338	20.49	24.77	27.59	33.41
7.015	9.390	10.865	13.675	17.338	21.60	25.99	28.87	34.80
7.633	10.117	11.651	14.562	18.338	22.72	27.20	30.14	36.19
8.260	10.851	12.443	15.452	19.337	23.83	28.41	31.41	37.57
9.542	12.338	14.041	17.240	21.337	26.04	30.81	33.92	40.29
10.856	13.848	15.659	19.037	23.337	28.24	33.20	36.41	42.98
12.198	15.379	17.292	20.843	25.336	30.43	35.56	38.88	45.64
13.565	16.928	18.939	22.657	27.336	32.62	37.92	41.34	48.28
14.953	18.493	20.599	24.478	29.336	34.80	40.26	43.77	50.89
22.164	26.509	29.051	33.660	39.335	45.62	51.80	55.76	63.69
27.707	34.764	37.689	42.942	49.335	56.33	63.17	67.50	76.15
37.485	43.188	46.459	52.294	59.335	66.98	74.40	79.08	88.38