1ST SEM. 2007/2008

UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER

PROGRAMME:	**BSc Agricultural Education; Agronomy; Animal Science and Horticulture II**
COURSE CODE:	**APH 206**
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. Explain why you would expect genetic differences between cells to arise from meiosis and not from mitosis. What is the significance of these genetic differences in agriculture? **(10 Marks)**

b. Silky feathers in chickens are caused by a gene whose effect is recessive to that of normal feathers.

   i. If 128 birds were raised from a cross between individuals that were heterozygous for this gene, how many would be expected to be silky and how many normal? **(3 Marks)**

   ii. If you had a normal feathered chicken, what would be the easiest way to determine whether it is homozygous or heterozygous? **(3 Marks)**

c. Explain the concept of graded dominance using the gene that govern coat colour in wild rabbits as an example. **(5 Marks)**

d. Distinguish between dominant epistasis and recessive epistasis giving appropriate examples. **(5 Marks)**

e. Explain the following terms:
   i. Concordance
   ii. Phenocopies
   iii. Pleiotropy
   iv. Dihybrid
   v. Sex linkage **(10 Marks)**

f. Describe the expected genotypes and phenotypes of offspring born to a woman with normal vision, but a carrier of the colourblindness gene, married to a man with normal vision. **(4 Marks)**

QUESTION 2

Albinism and hair color are governed by different genes. A recessively inherited form of albinism causes affected individuals to lack pigment in their skin, hair and eyes. In hair color, red hair is inherited as a recessive trait, and brown hair is inherited as a dominant trait. An albino woman whose parents both have red hair has two children with a man who is normally pigmented and has brown hair. The brown-haired partner has one parent who has red hair. The first child is normally pigmented and has brown hair. The second child is albino. Using defined symbols of your choice to represent the genes for hair colour and skin pigmentation answer the following questions:

    a. What is the genotype of the albino female parent for hair colour?

                          (2 Marks)

    b. What is the genotype of the brown-haired male parent with respect to:

        i.   Hair color?   **(3 Marks)**

        ii.   Skin pigmentation?   **(3 Marks)**

    c. What is the genotype of the first child with respect to:

        i.   Hair colour?   **(3 Marks)**

        ii.   Skin pigmentation?   **(3 Marks)**

    d. What are the possible genotypes of the second child for hair color?

                          (4 Marks)

    e. What is the phenotype of the second child for hair color? Explain.

                          (2 Marks)

QUESTION 3

    a. Gene mutations refer to sudden heritable changes in genetic material. With the aid of diagrams and/or examples, where appropriate, explain the following types of mutations:

        i.   Samesense mutations

        ii.   Nonsense mutations

        iii.   Missense mutations

        iv.   Frameshift mutations

        v.   Lethal mutations   **(10 Marks)**

b. In sheep, white wool is dominant to black. At times black wool appears in a flock of sheep. Black wool is worthless because it cannot be dyed. How can you eliminate the alleles for black wool in your flock?   **(5 Marks)**

c. Explain the blending theory of inheritance. From Mendel's experiments with garden peas, what evidence is there that the blending theory of inheritance is incorrect?   **(5 Marks)**

QUESTION 4

a. Test the hypothesis that the observation of 35 tall and 25 short plants arise from a cross between two heterozygotes, Tt x Tt. Use $\alpha = 0.05$.

(5 Marks)

b. In Shorthorn cattle, red coat colour is incompletely dominant over white coat colour such that the heterozygote is a colour mixture called roan where both red and white hairs are mixed together. Using symbols of your choice to denote the genes, determine the genotypes and phenotypes of the offspring from the following crosses:
   i.   Red cow x White bull
   ii. Roan cow x Roan bull
   iii. Roan cow x Red bull   **(9 Marks)**

c. Explain how autotetraploid organisms arise and what (if any) role they play in agriculture.   **(6 Marks)**

QUESTION 5

The relations between genes and their phenotypic effects are not always straightforward. The genes interact with the environment throughout an organism's lifetime to form the phenotype.

a. Distinguish between penetrance and expressivity.   **(5 Marks)**

b. Explain the effects of external and internal environment on gene expression. Use appropriate examples where possible.   **(15 Marks)**

Percentage Points of the Chi-Square Distribution

Degrees of freedom	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
1	0.000	0.000	0.016	0.102	0.455	1.32	2.71	3.84	6.63
2	0.020	0.103	0.211	0.575	1.386	2.77	4.60	5.99	9.21
3	0.115	0.352	0.584	1.213	2.366	4.11	6.25	7.81	11.34
4	0.297	0.711	1.064	1.923	3.357	5.38	7.78	9.49	13.28
5	0.554	1.145	1.610	2.675	4.351	6.63	9.24	11.07	15.09
6	0.872	1.635	2.204	3.455	5.348	7.84	10.64	12.59	16.81
7	1.239	2.167	2.833	4.255	6.346	9.04	12.02	14.07	18.47
8	1.646	2.733	3.490	5.017	7.344	10.22	13.36	15.51	20.09
9	2.088	3.325	4.168	5.899	8.343	11.39	14.68	16.92	21.67
10	2.568	3.940	4.865	6.737	9.342	12.55	15.99	18.31	23.21
11	3.053	4.575	5.578	7.584	10.341	13.70	17.27	19.67	24.72
12	3.571	5.226	6.304	8.438	11.340	14.84	18.55	21.03	26.22
13	4.107	5.892	7.042	9.299	12.340	15.98	19.81	22.36	27.69
14	4.660	6.571	7.790	10.165	13.339	17.12	21.06	23.68	29.14
15	5.229	7.261	8.547	11.036	14.339	18.25	22.31	25.00	30.58
16	5.812	7.962	9.312	11.912	15.338	19.37	23.54	26.30	32.00
17	6.408	8.672	10.085	12.792	16.338	20.49	24.77	27.59	33.41
18	7.015	9.390	10.865	13.675	17.338	21.60	25.99	28.87	34.80
19	7.633	10.117	11.651	14.562	18.338	22.72	27.20	30.14	36.19
20	8.260	10.851	12.443	15.452	19.337	23.83	28.41	31.41	37.57
22	9.542	12.338	14.041	17.240	21.337	26.04	30.81	33.92	40.29
24	10.856	13.848	15.659	19.037	23.337	28.24	33.20	36.41	42.98
26	12.198	15.379	17.292	20.843	25.336	30.43	35.56	38.88	45.64
28	13.565	16.928	18.939	22.657	27.336	32.62	37.92	41.34	48.28
30	14.953	18.493	20.599	24.478	29.336	34.80	40.26	43.77	50.89
40	22.164	26.509	29.051	33.660	39.335	45.62	51.80	55.76	63.69
50	27.707	34.764	37.689	42.942	49.335	56.33	63.17	67.50	76.15
60	37.485	43.188	46.459	52.294	59.335	66.98	74.40	79.08	88.38