1ST SEM. 2008/2009

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**

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QUESTION 1 (*COMPULSORY*)

a. Explain the following:

   i. Blending theory of inheritance

   ii. Chromosome theory of inheritance **(6 Marks)**

b. Explain why meiosis leads to significant genetic variation while mitosis does not. What is the importance of this genetic variation in agriculture?

(10 Marks)

c. A recessive mutant allele, black, causes very dark body in *Drosophila melanogaster* (fruit fly) when homozygous. The wild-type (normal) colour is grey. What F_1 phenotypic and genotypic ratios are predicted when a black female is crossed with a grey male whose father was black? **(4 Marks)**

d. In radishes, flower colour may be red, purple, or white. The edible portion of the radish may be long or oval. When only flower colour is studied, no dominance is evident, and red x white crosses yield all purple. If these F_1 purples are interbred, the F_2 generation consists of ¼ red: ½ purple: ¼ white. Regarding radish shape, long is dominant to oval in a normal Mendelian fashion.

   i. Determine the F_1 and F_2 phenotypes from a cross between a true-breeding red, long radish and one that is white and oval. Be sure to define all gene symbols initially. **(6 marks)**

   ii. A red oval plant was crossed with a plant of unknown genotype and phenotype, yielding the following offspring:

   103 red long : 101 red oval

   98 purple long : 100 purple oval

Determine the genotype and phenotype of the unknown plant. **(4 Marks)**

e. Using examples, where appropriate, explain:

i. Multiple alleles **(2 Marks)**

ii. Pangenesis **(2 Marks)**

iii. Incomplete dominance **(2 Marks)**

iv. Nullisomic **(2 Marks)**

v. Co-dominance **(2 Marks)**

QUESTION 2

a. With the aid of examples, where appropriate, explain the following terms:

i. Heterogametic sex **(2 Marks)**

ii. Sex limited trait **(2 Marks)**

iii. Hemizygosity **(2 Marks)**

iv. Dosage compensation **(2 Marks)**

v. Klinefelter's syndrome **(2 Marks)**

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

c. Haemophilia is a hereditary disease caused by a sex-linked recessive allele in humans. A young woman known to be a carrier of this allele marries a normal man. If they get 12 children, how many of them are expected to be haemophilic? **(5 Marks)**

QUESTION 3

a. A geneticist, in assessing data that fell into two phenotypic classes observed values of 250 : 150. She decided to perform a chi-square analysis using two different null hypotheses:

i. The data fit a 3 : 1 ratio; and

ii. The data fit a 1 : 1 ratio.

Calculate the χ^2 values for each hypothesis. What can you conclude about each hypothesis? **(6 Marks)**

b. In the guinea pig, a locus controlling coat colour may be occupied by any of four alleles: C (full colour), c^k (sepia), c^d (cream), or c^a (albino). A progressive

order of dominance exists among these alleles when they are present heterozygously: $C > c^k > c^d > c^a$. Determine the genotype of each individual, and predict the phenotypic ratios of the offspring in the following crosses:

i. Sepia x cream (where both had an albino parent)

ii. Sepia x cream (where the sepia individual had an albino parent and the cream individual had two sepia parents) **(10 Marks)**

c. Why is it important to know the blood type of an individual when blood transfusion is to be done? **(4 Marks)**

QUESTION 4

With the aid of appropriate examples, write short notes on:

a. XY sex determination system **(4 Marks)**

b. XX/X0 sex determination **(4 Marks)**

c. Environmental sex determination **(4 Marks)**

d. Phenocopies **(4 Marks)**

e. X-chromosome inactivation **(4 Marks)**

QUESTION 5

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

b. Discuss the effects of 3 external and 2 internal environmental factors on gene expression. **(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