1ˢᵀ SEM. 2008/2009

UNIVERSITY OF SWAZILAND

SUPPLEMENTARY 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 <u>MUST</u> ANSWER <u>QUESTION 1</u> AND ANY OTHER 3 QUESTIONS.

ALL WORKING MUST BE CLEARLY SHOWN

REQUIREMENTS: CALCULATOR AND STATISTICAL TABLES

DO NOT OPEN THIS PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE CHIEF INVIGILATOR

QUESTION 1 (*COMPULSORY*)

a. 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 $\alpha = 0.05$).   **(10 Marks)**

b. Albinism in humans is inherited as a simple recessive trait. Determine the genotypes of the parents and offspring for the following families. Where two alternative genotypes are possible, list both.

    i. Two normal (nonalbino) parents have 5 children, 4 normal and 1 albino.

    ii. A normal male and an albino female have six children, all normal.

                                            (4 Marks)

c. Assuming segregation and independent assortment, how many different types of gametes can be formed by individuals of the following genotypes? In each case indicate the allelic constitution of the gamete(s).

    i. AAbb,

    ii. AaBb,

    iii. Aabb,

    iv. AABbCc,

    v. AaBbCc.   **(10 Marks)**

d. With the aid of a table, contrast meiosis and mitosis   **(6 Marks)**

e. A cross between plants true-breeding for axial flowers and plants true-breeding for terminal flowers gave F_1 plants of all of which produced axial flowers. Selfing the F_1 plants gave F_2 plants in which 75% produced axial flowers while the remainder produced terminal flowers.

    i. Which trait is dominant? Explain your answer.   **(3 Marks)**

f. In garden peas, grey seed colour is dominant to white seed colour. In the following experiments, parents with known phenotypes but unknown genotypes produced the listed progeny:

Parents	Progeny	
	Grey	White
1. grey x white	82	78
2. grey x grey	118	39
3. white x white	0	50
4. grey x white	74	0
5. grey x grey	90	0

   i. Using the letter *G* for grey gene and *g* for white, give the most probable genotype of each parent. **(5 Marks)**

g. State Mendel's law of independent assortment. **(2 Marks)**

QUESTION 2

a. Wooly, sharply curled hair is caused by a rare dominant gene in European populations. A woman with wooly hair with blood group O marries a man with straight hair (normal) with blood group AB.

   i. What are the chances that they will have a wooly haired group B child?

   ii. What are the chances that they will have a normal-haired group B child?

   (6 Marks)

b. Explain the following terms in relation to gene interactions:

   i. Modifiers

   ii. Pleiotropism

   iii. Lethality

   iv. Dominant epistasis **(12 Marks)**

c. Define parthenogenesis giving appropriate examples. **(2 Marks)**

QUESTION 3

a. In chickens, some birds have uniformly coloured feathers (non-barred) whilst others have stripes of light and dark colouring (barred). A poultry breeder crosses a barred male to a non barred female and finds that all the progeny are

barred. However, the reciprocal cross gave barred males and non-barred females.

    i.   What do the results tell you about the inheritance of this trait?

(2 Marks)

    ii. Using clearly stated symbols of your choice, state the genotypes of the parents and progeny in both the forward and the reciprocal crosses described in (a) above. **(6 Marks)**

  b. 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? **(12 Marks)**

QUESTION 4

Define these pairs of terms, and distinguish between them

  a. Aneuploidy and euploidy

  b. Autopolyploid and allopolyploid

  c. Autotetraploid and amphidiploid

  d. Paracentric inversion and pericentric inversion

  e. Monosomy and trisomy   **(20 Marks)**

QUESTION 5

a. A newly married couple has planned to have only 4 children. If their wish is to get 2 daughters and 2 sons, what is the probability that their wish will come true?

(4 Marks)

b. Albinism and hair colour 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 colour, 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.

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

(2 Marks)

    ii. What is the genotype of the brown-haired parent with respect to hair colour? Skin pigmentation? **(4 Marks)**

iii. What is the genotype of the first child with respect to hair colour and skin pigmentation? **(4 Marks)**

iv. What are the possible genotypes of the second child for hair colour?

(2 Marks)

v. What is the phenotype of the second child for hair colour? Explain?

(4 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