



**1<sup>ST</sup> SEM. 2007/2008**

**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 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. Contrast the following pairs of terms:
- i. Allele and locus
  - ii. Genotype and phenotype
  - iii. Reciprocal cross and test cross
  - iv. Incomplete dominance and co-dominance **(12 Marks)**
- b. State Mendel's first and second laws and explain what they mean. **(8 Marks)**
- c. Using a table, compare and contrast mitosis and meiosis. **(10 Marks)**
- d. Distinguish between sex-limited and sex-influenced traits giving appropriate examples. **(5 Marks)**
- e. Why is it important to know the blood type of an individual before blood transfusion is done? **(5 Marks)**

**QUESTION 2**

- a. Polydactyly (extra digits) is a dominant trait caused by gene  $P$ , as opposed to the normal allele,  $p$ . Cystic fibrosis,  $c$ , is a recessive disease, as opposed to the normal condition,  $C$ . A polydactylous woman, otherwise normal in phenotype, marries a healthy normal man. Their four children have the following phenotypes:
- Child 1 is normal in all respects,  
Child 2 is polydactylous, otherwise normal,  
Child 3 has cystic fibrosis, otherwise normal,  
Child 4 has cystic fibrosis and is polydactylous.
- i. What is the genotype of the mother? **(4 Marks)**
  - ii. What is the genotype of child 3? **(3 Marks)**
  - iii. What is the genotype of child 4? **(3 Marks)**
  - iv. What is the chance that child 1 is heterozygous for cystic fibrosis? **(4 Marks)**

b. Using appropriate examples, explain:

- i. Co-dominance
- ii. Incomplete dominance
- iii. Overdominance

**(6 Marks)**

**QUESTION 3**

a. Haemophilia is caused by a sex-linked recessive gene in humans. A haemophilic man mates with a carrier non-haemophilic woman. Using clearly defined symbols of your choice answer the following questions:

- i. Describe the genotypes and phenotypes (including sex) of offspring resulting from this cross. What proportion of males and female offspring will be haemophiliacs? **(5 Marks)**
- ii. If a daughter produced by the mating above is mated to a normal male, what proportion (and sexes) will be haemophilic among their offspring? **(5 Marks)**

b. What does it mean to say that a person is a 'carrier' of a sex linked character?

**(4 Marks)**

c. Explain why x-linked recessive abnormalities are more common in men than in women.

**(3 Marks)**

d. Define parthenogenesis, giving appropriate examples.

**(3 Marks)**

**QUESTION 4**

a. Seeds from a tall garden pea plant (Tt) produced 30 tall and 20 short offspring. We do not know whether this was through self-fertilisation or a cross with a short (tt) plant. Using a 5% level of significance, perform a statistical test to establish whether self-fertilisation or a cross with a short plant occurred resulting in the observed offspring. **(10 Marks)**

b. Consider a cross between a tall (Tt) pea plant and a short (tt) pea plant that produces a total of 4 offspring. What is the probability that 3 offspring are tall? **(4 Marks)**

- c. Consider a cross between two tall (Tt) pea plants that produces a total of 12 offspring. What is the probability that 4 offspring are homozygous dominant and 3 are homozygous recessive for plant height? **(6 Marks)**

**QUESTION 5**

- a. Define the following terms:

- i. Chromosome
- ii. Haploid
- iii. Diploid
- iv. Polyploidy
- v. Sister chromatids

**(10 Marks)**

- b. Write notes on any FOUR sex determination mechanisms in animals.

**(10 Marks)**

## Percentage Points of the Chi-Square Distribution

Degrees of freedom	Probability of a larger value of $\chi^2$									
	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	29.19	36.19	
20	8.260	10.851	12.443	15.452	19.337	23.83	28.41	30.14	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	