UNIVERSITY OF SWAZILAND
FINAL EXAMINATION PAPER

PROGRAMME: DIPLOMA IN AGRICULTURE YEAR II,
DIPLOMA IN AGRICULTURE EDUCATION YEAR II
REMEDIAL YEAR IN AGRICULTURE AND
REMEDIAL YEAR IN AGRICULTURE EDUCATION

COURSE CODE: APH 202

TITLE OF PAPER: PRINCIPLES OF GENETICS

TIME ALLOWED: TWO (2) HOURS

INSTRUCTIONS:
1. ANSWER QUESTION 1 AND ANY OTHER THREE QUESTIONS.
2. EACH QUESTION CARRIES TWENTY FIVE (25) MARKS.)
3. ILLUSTRATE YOUR ANSWERS WITH LARGE AND CLEARLY LABELLED DIAGRAMS WHERE APPROPRIATE.
4. ALL WORKING MUST BE CLEARLY SHOWN.

SPECIAL REQUIREMENTS: a) CALCULATORS
STATISTICAL TABLES (BACK PAGE)

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QUESTION 1 **THIS QUESTION IS COMPULSORY**

a) State Mendel's laws.   **(4 marks)**

b) In cattle, the presence of horns is determined by a single gene with two alleles as follows:

P-polled (horns absent)   p-horned

Predict what progeny and in what proportions can be expected in the following crosses.

Cross	Sire	Dam
i	PP	PP
ii	PP	Pp
iii	Pp	Pp
iv	Pp	pp
V	PP	Pp

                                                    (10 marks)

c) In some cattle, the gene for black colour is dominant over the gene for red colour (B-Black; b-red). A black, polled bull is crossed to a red, horned cow over a number of years to produce an F_1.

   i.   State the genotypes of the bull and the cow.   **(2 marks)**

   ii. State the genotype of the F_1.   **(1 marks)**

   iii. If the F_1 were allowed to intercross, state what genotypes and in what proportions could be expected among the F_2. Indicate the phenotypes associated with each genotype.   (8 marks)

                                            [TOTAL 25 MARKS]

QUESTION 2

a) Name four aneuploid conditions known to you and explain how these might arise.
    (6 marks)

b) In humans, if a female undergoes non-disjunction of the sex chromosomes and is
    fertilized by a normal male, explain what karyotypes might arise amongs her
    progeny. **(4 marks)**

c) State **three** conditions caused by abnormalities in chromosome number in cattle
    including an account of the karyotype and the symptoms associated
    with each. **(15 marks)**

                                                      [TOTAL 25 MARKS]

QUESTION 3

a) A man allows his albino Labrador retriever bitch to mate with a friend's albino
    male resulting in all black puppies in the F_1. The F_1 is allowed to intercross
    resulting in an F_2 with a total of 52 puppies as follows:

    29 Black; 8 brown and 15 albino.

    i)   Suggest an explanation for the inheritance of this trait.   **(2 marks)**

    ii) Test how well the results fit your hypothesis.   **(4 marks)**

    iii) Using clearly stated symbols of your choice, state the
         genotypes of the bitch, male and F_1 and all F_2 phenotypes
         in this cross.   **(8 marks)**

b) Distinguish between penetrance and expressivity.   **(2 marks)**

c) In chickens, the gene for barred feathers is sex-linked. If a
    barred hen is allowed to mate with a non-barred cock.

d) i) Show what phenotypes and in what proportions can be expected
       in the resulting brood.   **(5 marks)**

   ii) Show what phenotypes and in what proportions can be
        expected in the reciprocal cross.   **(4 marks)**

                                           [TOTAL 25 MARKS]

QUESTION 4

a) Explain the link between proteins and DNA using large, clearly labeled diagrams to illustrate your answer. **(8 marks)**

b) Briefly state the main events that occur during the main stages of replication. **(10 marks)**

c) Explain how pre-mRNA is processed to resulting in a final mRNA transcript. **(7 marks)**

[TOTAL 25 MARKS]

QUESTION 5

a) Explain what is meant by quantitative inheritance. **(2 marks)**

b) Briefly distinguish between quantitative and qualitative inheritance. **(6 marks)**

c) In a large herd of cattle, three different characters showing continuous distribution are measured, and the variances below are obtained:

Variance	Characters		
	Shank length	Neck length	Fat content
Phenotypic	310.2 .	730.4	106.0
Environmental	248.1	292.2	53.0
Additive genetic	46.5	73.0	42.4
Dominance genetic	15.6	365.2	10.6

i. Calculate the broad and narrow sense heritability for each character. **(9 marks)**

ii) In the population of animals studied, which character would respond best to selection. State the reasons for your answer. **(3 marks)**

d) Briefly explain what is meant by QTL analysis. **(5 marks)**

[TOTAL 25 MARKS]

df\area	.995	.990	.975	.950	.900	.750	.500	.250	.100	.050	.025	.010	.005
1	0.00004	0.00016	0.00098	0.00393	0.01579	0.10153	0.45494	1.32330	2.70554	3.84146	5.02389	6.63490	7.87944
2	0.01003	0.02010	0.05064	0.10259	0.21072	0.57536	1.38629	2.77259	4.60517	5.99146	7.37776	9.21034	10.59663
3	0.07172	0.11483	0.21580	0.35185	0.58437	1.21253	2.36597	4.10834	6.25139	7.81473	9.34840	11.34487	12.83816
4	0.20699	0.29711	0.48442	0.71072	1.06362	1.92256	3.35669	5.38527	7.77944	9.48773	11.14329	13.27670	14.86026
5	0.41174	0.55430	0.83121	1.14548	1.61031	2.67460	4.35146	6.62568	9.23636	11.07050	12.83250	15.08627	16.74960
6	0.67573	0.87209	1.23734	1.63538	2.20413	3.45460	5.34812	7.84080	10.64464	12.59159	14.44938	16.81189	18.54758
7	0.98926	1.23904	1.68987	2.16735	2.83311	4.25485	6.34581	9.03715	12.01704	14.06714	16.01276	18.47531	20.27774
8	1.34441	1.64650	2.17973	2.73264	3.48954	5.07064	7.34412	10.21885	13.36157	15.50731	17.53455	20.09024	21.95495
9	1.73493	2.08790	2.70039	3.32511	4.16816	5.89883	8.34283	11.38875	14.68366	16.91898	19.02277	21.66599	23.58935
10	2.15586	2.55821	3.24697	3.94030	4.86518	6.73720	9.34182	12.54886	15.98718	18.30704	20.48318	23.20925	25.18818
11	2.60322	3.05348	3.81575	4.57481	5.57778	7.58414	10.34100	13.70069	17.27501	19.67514	21.92005	24.72497	26.75685
12	3.07382	3.57057	4.40379	5.22603	6.30380	8.43842	11.34032	14.84540	18.54935	21.02607	23.33666	26.21697	28.29952
13	3.56503	4.10692	5.00875	5.89186	7.04150	9.29907	12.33976	15.98391	19.81193	22.36203	24.73560	27.68825	29.81947
14	4.07467	4.66043	5.62873	6.57063	7.78953	10.16531	13.33927	17.11693	21.06414	23.68479	26.11895	29.14124	31.31935
15	4.60092	5.22935	6.26214	7.26094	8.54676	11.03654	14.33886	18.24509	22.30713	24.99579	27.48839	30.57791	32.80132
16	5.14221	5.81221	6.90766	7.96165	9.31224	11.91222	15.33850	19.36886	23.54183	26.29623	28.84535	31.99993	34.26719
17	5.69722	6.40776	7.56419	8.67176	10.08519	12.79193	16.33818	20.48868	24.76904	27.58711	30.19101	33.40866	35.71847
18	6.26480	7.01491	8.23075	9.39046	10.86494	13.67529	17.33790	21.60489	25.98942	28.86930	31.52638	34.80531	37.15645
19	6.84397	7.63273	8.90652	10.11701	11.65091	14.56200	18.33765	22.71781	27.20357	30.14353	32.85233	36.19087	38.58226
20	7.43384	8.26040	9.59078	10.85081	12.44261	15.45177	19.33743	23.82769	28.41198	31.41043	34.16961	37.56623	39.99685