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UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER 2005

TITLE OF PAPER: GENETICS

COURSE CODE: B303

TIME ALLOWED: THREE HOURS

INSTRUCTIONS:
1. ANSWER ANY **FOUR** 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 (CANDIDATES MAY BRING THEM)
b) STATISTICAL TABLES (BACK PAGE)

THIS PAPER IS NOT TO BE OPENED UNTIL PERMISSION HAS

BEEN GRANTED BY THE INVIGILATORS

COURSE CODE: B303 (M) 2004

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QUESTION 1

a) Explain fully, the mechanism of transcription using **large, clearly labeled** diagrams to illustrate your answer. **[15 Marks]**

b) Explain how the resulting transcript is further processed prior to being used in protein synthesis in the cytoplasm. **[5 marks]**

c) Briefly explain the link between DNA and RNA and how the two molecules act to control cellular activity. **[5 Marks]**

[TOTAL 25 MARKS]

QUESTION 2

a) In the Corn Snake, skin colour is controlled by two genes O and B as follows:

O- orange pigment produced   B- Black pigment produced

o- no orange pigment produced   b- no black pigment produced

A snake breeder crosses two snakes of genotypes OObb and ooBB to obtain an F_1 which he then intercrosses to produce an F_2.

    i. State the phenotypes of the two parents. **[2 Marks]**

    ii. State the genotype and the phenotype of the F_1. **[1 Mark]**

    iii. What genotypes and in what proportions can be expected in the F_2? State the phenotypes associated with these genotypes.
        [7 Marks]

b) In some varieties of dogs, when true-breeding brown dogs are mated with true-breeding white dogs, all F_1 puppies are white. When some F_1 dogs were allowed to freely intercross they produced the following phenotypes:

Coat colour	No. individuals
White	118
Black	32
Brown	10

i. Propose an explanation for the inheritance of this trait. **[3 Marks]**
ii. Use X^2 to test how well the results fit your hypothesis. **[5 Marks]**
iii. Using clearly stated symbols of your choice, state the genotypes of all individuals in this cross. **[7 Marks]**

[TOTAL 25 MARKS]

QUESTION 3

a) Explain what landmarks can be used to study chromosomal rearrangements. **[8 Marks]**

b) Name four chromosomal aberrations known to you and explain how these might arise. **[8 Marks]**

c) An individual is heterozygous for the inversion •FIHGJ where • represents the position of the centromere. With the aid of large, clearly labeled diagrams, explain the consequences and show what meiotic products may form if crossing over occurs in this region of the chromosome. **[9 Marks]**

[TOTAL 25 MARKS]

QUESTION 4

a) Four babies are born to different sets of parents in a hospital and are accidentally mixed up. If the blood groups of the babies are A, B, AB and O and those of the parents are as follows

Couple	Blood groups
1	AB X O
2	A X O
3	A X AB
4	O X O

Match each baby to its parents. **[4 Marks]**

b) If the parent of blood group A in couple 3 is heterozygous, explain what blood groups and in what ratios can be expected amongst their children.

[3 Marks]

c) In order to produce children of all four ABO blood groups, what would the genotypes of the two parents have to be? **[4 Marks]**

d) Consider the genotypes of two lines of chickens: The pure-line Mottled Hondan is iiDDMMWW whilst that of the pure-line Leghorn is IIddmmww where:

I- White feathers; i- Colored feathers

D- Duplex comb; d- Simplex comb

M- Bearded; m- Beardless

W- White skin; w- Yellow skin

A breeder crosses these two pure-lines to produce an F_1 which he then crosses to produce an F_2.

i. State the genotype and the phenotype of the F_1. **[2 Marks]**
ii. Predict what phenotypes, and in what proportions can be expected in the F_2 of this cross. **[10 Marks]**
iii. Distinguish between penetrance and expressivity. **[2 Marks]**

[TOTAL 25 MARKS]

QUESTION 5

An individual heterozygous for four genes, $A/a \cdot B/b \cdot C/c \cdot D/d$, is test-crossed to $a/a \cdot b/b \cdot c/c \cdot d/d$, and 1000 progeny are classified by the gametic contribution of the heterozygous parent as follows:

$a \cdot B \cdot C \cdot D$	42
$A \cdot b \cdot c \cdot d$	43
$A \cdot B \cdot C \cdot d$	140
$a \cdot b \cdot c \cdot D$	145
$a \cdot B \cdot c \cdot D$	6
$A \cdot b \cdot C \cdot d$	9
$A \cdot B \cdot c \cdot d$	305
$a \cdot b \cdot C \cdot D$	310

a. Which of these genes are linked? **[3 Marks]**
b. If two pure-breeding lines had been crossed to produce the heterozygous individual, what would their genotypes have been? **[2 Marks]**

    c. Draw a linkage map of the linked genes, showing the order and the
distances in map units. **[8 Marks]**

    d. Calculate an interference value, if appropriate. **[3 Marks]**

    e. Explain the limitations you would face in trying to study linkage and
humans and describe one method that has been successfully applied for
this purpose. **[9 Marks]**

[TOTAL 25 MARKS]

QUESTION 6

    a. Explain what is meant by extrachromosomal inheritance giving
two specific examples to illustrate your answer. **[10 Marks]**.

    b. Explain the inheritance of shell coiling in snails. **[5 Marks]**

    c. Discuss the importance of extrachromosomal inheritance in crop
production. **[10 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