NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF APPLIED BIOLOGY AND BIOCHEMISTRY

BACHELOR OF SCIENCE HONOURS DEGREE

MAY 2011

GENETICS SBB 1204

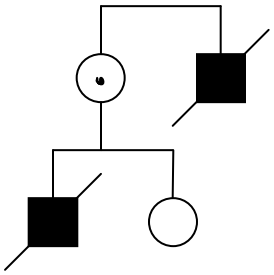
3 HOURS (100 MARKS)

INSTRUCTIONS

Answer Four (4) Questions. Each question carries 25 marks. Where a question contains subdivisions, the mark value for each subdivision is given in brackets. Illustrate your answer where appropriate with large, clearly labelled diagrams

---

1(a) In the pedigree below, the maternal uncle (I-2) and brother (II-1) of the consultand (II-2) were affected with Duchenne muscular dystrophy (DMD) a severe X-linked recessive disease. DMD carrier women can be diagnosed using a creatine phosphokinase (CPK) test. An elevated CPK level is an indication of one being a carrier, however, this occurs in 67% of DMD carriers, furthermore, 5% of non-carrier women have an abnormal serum CPK.



The consutand (II-2) took the test and her CPK levels was within normal limits.

(i) Using Bayesian analysis determine the probability that II-2 is a DMD carrier, given that she tested CPK negative. (12 marks)

(ii) If II-2 had a son, determine the probability that he will be affected by DMD. (3 marks)

(b) A geneticist crossed two sorghum lines, creating an F_1 hybrid segregating 6 loci. This hybrid was then self fertilized. Calculate:

(i) the number of different kinds of gametes produced by the F_1. (3 marks)

(ii) the number of genotypes and phenotypes generated in the F_2. (3 marks)

(iii) the proportion of F_2 genotypes that were heterozygous. (4 marks)

2(a) Describe the different types of chromosomal breaks and re-unions that result in variations in chromosome structure. (15 marks)

(b) Describe how a cytogeneticist would produce a monoploid plant and a diploid from the monoploid using tissue culture. (10 marks)

3. In Tuli cattle the genotype C^RC^R is phenotypically red, C^RC^W is roan (a mixture of red and white) and C^WC^W is white. A population of Tulis found in Gwanda district had 728 red, 924 roan and 215 white animals.

(a) Calculate the estimated frequencies of the C^R allele and the C^W allele in the gene pool of the population. (6 marks)
(b) If this population is completely panmictic, what zygotic frequencies will be expected in the next generation? (4 marks)
(c) Use an appropriate statistical test to determine if this cattle population is in Hardy-Weinberg equilibrium. (15 marks)

4. In tomato plants, the genes ***o*** (oblate = flattened fruit), ***p*** (peach = hairy fruit) and ***s*** (compound inflorescence = many flowers in a cluster) were found to be in chromosome 2. A testcross between an F1 heterozygote for all three genes and homozygous recessive for all the three genes gave the following results;

Phenotypes of the Testcross Progeny	Number of Individuals
+++	**73**
++s	**348**
+p+	**2**
+ps	**96**
o++	**110**
o+s	**2**
op+	**306**
ops	**63**

Using the above data determine;

(i) the genotypes of the homozygous parents used in making the F_1 heterozygotes; (2 marks)
(ii) the sequence of these three genes on the chromosome; (5 marks)
(iii) the recombination distances between the genes; and, (10 marks)
(iv) the coefficient of coincidence and interference for this cross. (8 marks)

5. Write short notes on the following;
   (i) mechanisms of sex determination in humans and insects; (10 marks)
   (ii) variance method of estimating the number of genes affecting a quantitative trait. (15 marks)

6. There are some exceptions to some of Mendel's assumptions and theories of inheritance. List and describe these exceptions using real life examples.

END OF EXAMINATION