



# THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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**MAIN EXAMINATION**

**JANUARY – APRIL 2017 TRIMESTER**

**FACULTY OF SCIENCE**

**DEPARTMENT OF BIOLOGY**

**SCHOOL FOCUSED PROGRAMME**

**BIO 200: GENERAL GENETICS**

**Date: April 2017**

**Duration: 2 Hours**

**INSTRUCTIONS: Answer Question ONE and any other TWO Questions**

Q1.

- i. a). A family of six includes four children, each of whom has a different blood type: A, B, AB and O. What are the genotypes of parents for this trait? **(2marks)**  
  
b). In humans, sickle-cell anemia is caused by a recessive lethal allele  $Hb^s$ ; individuals who are  $Hb^aHb^s$  have sickle-cell trait, but are healthy.
  - i). What is the probability of two heterozygous individuals giving birth to a child with no sickle-cell trait? **(1mark)**
  - ii). What is the probability of two heterozygous individuals giving birth to a child with sickle-cell trait? **(1mark)**
- ii. A woman heterozygous for polydactyly (extra fingers and toes), a dominant trait, is married to a normal man. What is the probability of producing an offspring that has extra fingers or toes? **(3marks)**
- iii. In peas, some plants have shallowly crenated edges and others have deeply incised leaves. A cross is made between homozygous deep and shallow individuals. The shallow trait is dominant.
  - a). Using S and s to symbolize the genes for this trait, give the phenotypic and genotypic ratios for the F1 generation. **(2marks)**

- b). If self-pollination is allowed, what is the genotypic and phenotypic ratio for the F<sub>2</sub> generation? **(3marks)**
- iv. In the fruit fly *Drosophila melanogaster*, vestigial wings (v<sup>+</sup>) and hairy body (h) are produced by two recessive genes located on different chromosomes. The normal alleles, long wings (v) and hairless body (H) are dominant.
- a). Give the genotype and phenotype of F<sub>1</sub> progeny obtained from a cross between a vestigial-winged, hairy male and a normal, homozygous female. **(4marks)**
- b). If the F<sub>1</sub> from this cross are permitted to mate randomly among them, what phenotypic ratio would be expected in the F<sub>2</sub> generation? **(4marks)**
- v. List the characteristic traits for the following patterns of inheritance.
- a). Autosomal dominant inheritance **(3marks).**
- b). x-linked recessive inheritance **(3marks).**
- vi. a). What is euploidy? (1mk)
- b). Explain 3 conditions that may cause aneuploidies? **(3 marks)**

Q2.

- a). Birds use a ZZ-ZW chromosomal system of sex determination. Imagine that the P gene lies on the Z chromosome, and controls the brightness of their plumage. The dominant wild-type Z<sup>pb</sup> allele produces bright plumage, while the recessive variant Z<sup>pd</sup> allele produces dull plumage. If you cross a pure-breeding bright male with a pure-breeding dull female, then cross a male and a female from the F<sub>1</sub> generation with each other, what proportion of genotypes/phenotypes do you expect to see in the F<sub>2</sub> offspring? **(4marks).**
- b). Describe the other chromosomal system of sex determination mechanisms. Give two examples in each case. **(8marks).**
- c). Natasha and Demarcus are planning on having children. Each has a sister with sickle cell disease. Neither Natasha nor Demarcus nor any of their parents have the disease, and none of them has been tested to see if they have the sickle cell trait.
- i). Draw a pedigree representing this family. Be sure to clearly label Natasha and Demarcus **(5marks).**
- ii).Based on this incomplete information, calculate the probability that if this couple has a child, the child will have sickle cell trait **(3marks).**

Q3.

- a). What is the karyotype found in Turner's syndrome? **(3marks).**
- b). What is the difference between intra-allelic gene interaction and inter-allelic gene interaction? **(4marks)**
- c). Explain how you would determine an unknown parental genotype in a genetic cross **(4marks)**
- d). Describe and illustrate a case of recessive epistasis with reference to colour coat inheritance in house mice **(9marks).**

Q4.

Write short notes on the following genetic concepts. In each case give an example.

- i) Expressivity
- ii) Pleiotropism
- iii) Gene lethality in flowers
- iv) Dominant epistasis **(5 mks each).**

Q5. a). Give 4 reasons why a person may seek genetic counseling **(4marks)**

- b). Explain how gene mutations, genetic drift and natural selection may influence changes in the gene pool of naturally occurring populations **(6 marks)**
- c). Describe the various structural chromosomal mutations **(10 marks).**

**\*END\***