UNIVERSITY OF FORT HARE

AGC312

DEGREE EXAMINATIONS

June

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Time: 3 Hours

Subject: Introduction to genetics

Marks: 100

This paper consists of five (5) pages including the cover page

Internal Examiners

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INSTRUCTIONS

Answer any FIVE (5) questions

Question one ***(20 marks)***

a) Give brief definitions of the following terms;

i) Epistasis; **[1]**
ii) Sex linked gene. **[1]**

b) Eye colour is sex linked in fruit flies. Blue eyes (normal colour) are dominant to red eyes (mutant).

i) A heterozygous blue-eyed female is crossed with red-eyed male. What is the phenotypic ratio that will be expected among the F1? Show your working. **[4]**

ii) If a red eyed female from the above cross is crossed to a blue-eyed male, what are the genotypic and phenotypic ratios that are expected among the progeny? **[6]**

c) In *Drosophila melanogaster*, the gene for vestigial wings (V) is dominant to posterior wings (v). The gene for grey body (G) is dominant to brown body (g). These genes are known to be linked. A dihybrid was test crossed to double recessive genotype, vg/vg, and the following phenotypes were produced:

Phenotypes	**No. of Progeny**
Vestigial wings, Grey body	1112
Vestigial wings, Brown body	1800
Posterior wings, Grey body	1600
Posterior wings, Brown body	1018

(i) Calculate the percentage recombination between V and G, and then draw a linkage map of these genes. **[2]**

(ii) Discuss the linkage relationship between the genes. **[2]**

d) Describe the concept of a doublet code. Also explain its suitability to explaining the universally known genetic code. **[4]**

Question two ***(20 marks)***

a) Albinism is controlled by a single recessive gene. A normal woman whose father was an albino marries a man who is a carrier for the condition. What is the probability that the couple will have: i) An albino?; ii) A carrier? iii) A normal child who is a non-carrier? **[5]**

b) A homozygous parent carrying the recessive mutations curled wings (cu) and ebony body (e) is crossed to another parent that carries normal alleles for straight wings and ebony body. The F1 progeny produced were normal and heterozygous for both pairs of alleles. When F1 males were test-crossed with double recessive females, individuals of genotype "$\frac{Cu^{+}\ e}{Cu\ \ e}$"

had a frequency of 15%. Illustrate the test cross by showing genotypes that were used in the cross. **[2]**

c) What was the total frequency of parental type progeny among the testcross progeny? **[1]**

d) What is the distance between the genes "cu" and "e"? **[1]**

e) Based on the position of the kinetochore, list any four types of chromosomes that are known. **[4]**

f) The recessive allele ***s*** causes drosophila to have small wings, and the ***s**¹* allele causes normal wings. This gene is known to be X-linked. If a small winged male is crossed with a homozygous normal type female, what ratio of normal to small winged flies can be expected in the F1? **[4]**

g) Name any three features based upon which chromosomes can be distinguished morphologically. **[3]**

***Question three* (20 marks)**

a) Draw a well labeled diagram of a mature embryosac. **[4]**

b) Seed capsule shape is controlled by duplicate dominant genes. Allele A produces triangular shape and is dominant over ovoid shape (a). Allele B also produces a triangular shape, and is dominant to ovoid (b). What is the phenotypic ratio that will be expected among progeny from a cross between the following genotypes: Aabb x aaBb? Show your working. **[5]**

c) A woman went to give birth in Mount Frere Hospital. After successful delivery, her baby had to be taken to intensive care unit for routing procedures. When the baby returned, nurses were not sure which baby belonged to her, among the two babies that were now before them. Blood groupings of the ABO and MN systems were used to decide which of the two babies belonged to her. The facts were as follows:

	ABO System	MN System
Mother	AO	N
Father	B0	MN
Baby A	O	M
Baby B	AB	N

Which of the two babies belonged to her? Show your working and explain your reasoning. **[7]**

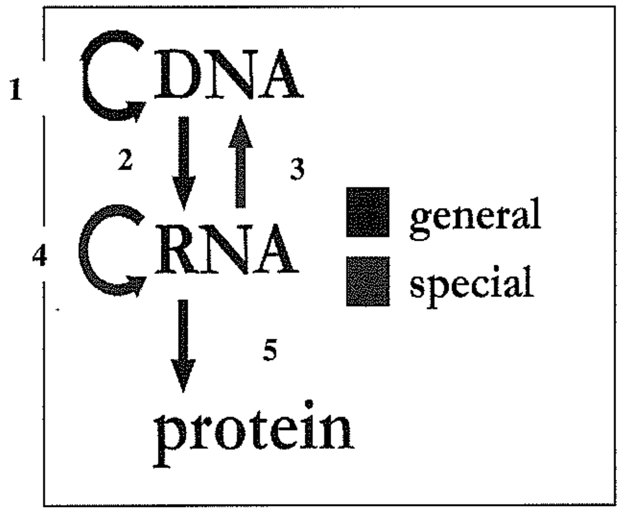
d) Give brief definitions of the following terms; **[4]**

i) Sex limited genes
ii) pleiotropism
iii) alternation of generations
iv) crossing over

<u>Question four</u> (20 marks)

a) List the three types of RNA that are known to exist in living organisms, and state the functions of each of them. **[6]**

b) The diagram below illustrates the central dogma. Name the processes numbered from 1 – 5. Additionally, also name the enzyme or structure that catalyses each of these processes. **[10]**



c) Name the following; (i) the base that is specific to RNA; and (iii) the base that is specific to DNA. **[2]**

d) If we test crossed a dihybrid individual in repulsion phase and obtained the following gametic proportions in the progeny:

- 32 % - Ab,
- 32 % - aB.

Calculate the proportion of gametes of genotype AB? Show all your working. **[2]**

<u>Question five</u> (20 marks)

Three genes, v w z, are linked in *Ipomea batatus*. Plants that were heterozygous for the three genes were test crossed with those that were completely recessive for all the three genes. When a sample of the offspring were counted, the following results were obtained:

Phenotype	Offspring
v w z	8
v + +	61
+ w +	83
v + z	91
+ + z	365
+ + +	10
+ w z	46
v w +	336

a) Which progeny classes are the parental types? **[2]**

b) Which progeny classes are the double recombinant types? **[2]**

c) What is the sequence of the genes? **[4]**

d) Calculate the map distances between the genes, and draw a linkage map of these loci. **[6]**

e) Determine the coefficient of coincidence and interference for these loci. **[4]**

f) What is a centromere and what is its use on a chromosome? **[2]**

<u>Question six</u> (20 marks)

a) Using a table, state any two differences between metaphase 1 of meiosis and metaphase two of meiosis. **[4]**

b) The ability to taste the chemical phenylthiocarbamide is an autosomal dominant phenotype (T). The inability to taste this chemical is recessive (t). A taster woman with a non-taster father marries a taster man who in the previous marriage had a non-taster daughter. What is the probability that their first child will be: **[5]**

(i) A nontaster
(ii) A taster.

c) Using a well labeled diagram, describe male gametogenesis in mammals. No further explanation is required. **[8]**

d) List any three tenets of the cell theory **[3]**