AFRICA UNIVERSITY
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"Investing in Africa's future"

COLLEGE OF HEALTH, AGRICULTURE AND NATURAL SCIENCES

NACP 217: GENETICS AND BIOTECHNOLOGY

END OF FIRST SEMESTER FINAL EXAMINATIONS

NOVEMBER/ DECEMBER 2020

LECTURER: MR. TABARIRA J.

DURATION: 24 HRS.

INSTRUCTIONS

Download the Question paper from the Moodle platform and work offline

Choose and Answer **One** question

DO NOT repeat material

Credit will be awarded for logical and systematic presentations

Question One

a. In rabbits, there is a coat colour gene located on the X chromosome. This gene has two alleles (grey and black). A heterozygous cat has spotted colour (mixture of grey and black). Predict the genotypic and phenotypic frequencies among the offspring of the following crosses. Pay careful attention to the genders of the offspring.

   i. Explain the nature of gene interaction of coat colour in rabbits **[2]**

   ii. Black female X grey male **[4]**

   iii. Grey female X Black male **[4]**

   iv. Spotted female X Black male **[4]**

   v. Spotted female X grey male **[4]**

   vi. Spotted female X spotted male **[4]**

b. Translation and transcription are key processes in living organisms. Clearly demonstrate your understanding of the two terms and outline how they relate for the survival of the organism. **[10]**

c. Discuss the perceived crop production and food security benefits developed economies are enjoying through adoption of GMO technology. **[25]**

d. Explain the differences in the fertilisation processes in plants (maize) and animals. **[10]**

e. Demonstrate how you will apply the knowledge you have gained in the Genetics and Biotechnology course in the field of Agriculture. **[20]**

f. Giving specific examples, explain the major challenges associated with chromosomal mutations/changes. **[10]**

g. What is the main difference between successive and simultaneous cytokinesis? **[3]**

Question Two

a. In rats, the following genotypes of two independently assorting genes determine coat colour:
   i. A-B- grey
   ii. A-bb yellow
   iii. aaB- black
   iv. aabb cream

   A third gene (assorts independently of "A" and "B") determines whether or not any colour is produced. The CC and Cc genotypes allow expression of A and B alleles as above, but cc genotype produces albinos regardless of genotype at A and B locus.

   Determine phenotypic ratios for AaBbCc x AaBbcc cross: **[12]**

b. GMO technology is meant to solve global food security challenges. Explain possible challenges of relying on this technology in addressing crop production and food security challenges in the small holder farming sector. **[25]**

c. The environment plays a key role in phenotypic expression observed in organisms. Provide a detailed explanation in support of this statement. **[25]**

a. Give genetic explanations, giving supporting evidence for the following observations:
   i. Phenotypic expression in different sexes are not always X-linked. **[5]**
   ii. A cross between two yellow mice produced a 2:1 phenotypic ratio. **[3]**
   iii. It is normal for male bees to produce gametes mitotically. **[3]**
   iv. Sperm and ova are not identical to the parent cells that produced them. **[3]**
   v. Males always inherit sex-linked characters from their maternal parents. **[3]**
   vi. A cross between tall plants produced a mixture of tall and dwarf plants. **[3]**
   vii. Biotechnology is perceived to disregard ethical consideration of organisms. **[5]**
   viii. Mitosis is the key process sustaining living organisms. **[6]**
   ix. Meiosis is the source of variation in organisms. **[4]**
   x. The ratio of males to females in human families is 1:1. **[3]**

Question Three

b. Give a detailed account of the perceived human health concerns associated with the adoption of GMO technology. **[25]**

c. Discuss in detail giving relevant examples in support of the notion that, presence of a gene in an organism does not guarantee its phenotypic expression. **[25]**

b. Discuss the circumstances (giving specific examples) under which the effect of the maternal gamete overrides the Mendelian principles of heredity. **[20]**

c. A paternity dispute has arisen in a family, with the alleged father denying responsibility of fathering the baby. You have been invited to assist the courts with in resolving this dispute. Advise the courts of the available options and clearly explain how each option can be used to come up with an informed decision. **[15]**

d. In fruit flies, the allele for wing shape can be 'curly' (Cy) or wild type (cy). The normal (wild type) allele is designated 'cy.' A fly homozygous for cy (cy cy) has normal, straight wings. The heterozygote (Cy cy) has wings which curl up on the ends (and, incidentally, can't really fly). The homozygote for the Cy allele is lethal in the homozygous condition (never hatches out of the egg).

   If two curly winged flies are mated, and the female lays 200 eggs, predict the following, showing appropriate workings:

   i. Explain the nature of gene interaction governing wing shape in fruit flies. **[3]**

   ii. How many eggs will produce living offspring? **[3]**

   iii. What percentage of the living offsprings do you expect to be straight winged flies? **[3]**

   iv. How many curly winged flies among the living offspring do you expect? **[3]**

   v. If the straight winged fly would mate a curly winged type would the percentage of living offspring change (support your answer). **[3]**

END OF EXAMINATION PAPER