



"Investing in Africa's Future"

COLLEGE OF HEALTH, AGRICULTURE & NATURAL SCIENCES

NACP217 GENETICS AND BIOTECHNOLOGY

END OF SEMESTER EXAMINATIONS

NOVEMBER 2019

LECTURER: DR. CHITEKA

DURATION: 3 HOURS

INSTRUCTIONS

Answer four questions in Section A and All of Section B.

SECTION A Answer four (4) questions from this section)

1a. Discuss the importance of mitosis to i) agriculture and ii) to the plant breeder. [4]

1b. A eukaryotic organism has $2n=6$ undergoes mitosis. One homologous pair is metacentric, one pair is metacentric and third is telocentric. Draw a cell that is in the mid anaphase stage of mitosis and label the key features that define this stage of mitosis. Describe what happens during anaphase and specify the importance of this stage. [8]

1c. What characteristics distinguish a bacterium from a fungus. [4]

1d. Discuss the elements of the chromosome theory of heredity. [4]

2a. A eukaryotic organism has $2n=8$. Draw a cell that is in the Zygotene stage of meiosis, show and label the bivalents. Briefly explain what happens during this stage the importance of the zygotene stage to the final product of the first meiotic division. [10]

2b. Discuss how chromosome behavior accounts for Mendel's laws. [10]

3. Discuss the processes involved in the development of the pollen grain beginning with the diploid microspore mother cell. [20]

4a. Two pure lines of genotype AA and aa are crossed where the locus is responsible for flower color where A (red flower colour) is dominant over white (a). Draw a diagram showing a cross between the genotypes and phenotypes of the two parents, the F1 progeny and the F2 progeny after one generation of selfing of the resulting F1 hybrid and show the genotypes and phenotypes of the F2 progeny. [8]

4b. A man called Kefas is married to Tatiana and they have three children, Zuma, Petros and Giaquinta. At primary school Zuma showed an outstanding performance, winning accolades. Giaquinta was average while Petros had a continually dismal performance. Kefas just began to suspect infidelity thinking that Petros was really not his child because of the deviant performance. You are given the clinical records that show the following blood group phenotypes for the family.

Name:	Kefas	Tatiana	Giaquinta	Zuma	Petros
Blood group phenotype:	BMN	ABM	ABMN	OM	BMN

Assign genotypes to the individuals, illustrate the crosses and determine whether there is evidence of infidelity. Show all your logic based on the genetics of the parents and the progeny. [10]

5. In rice (*Oryza sativa*), the presence of the purple anthocyanin pigment is determined by two gene pairs I and P both of which exhibit complete dominance. At gene pair (I) green is dominant over other

colours. At gene pair P, purple is dominant over green. At gene pair I the presence of a dominant allele masks the effect of the P locus.

- a) Deduce the phenotypes of the individuals with the genotype I^lpp and iiPP. [2]
- b) Diagram a cross between I^lpp and iiPP and give the phenotype of the F₁ progeny. [3]
- c) The F₁ progeny are selfed. Deduce the phenotypic categories and the phenotypic ratio of the F₂ progeny and give the phenotypic ratios. (Show the logical steps clearly). [8]
- d) Present a logical explanation for this epistatic interaction and give a name for the type of epistatic interaction. [7]

SECTION B

Answer all questions in this section. Write your responses in the spaces provided. Detach this from the question paper and submit it with your answer book.

6a. Define the gene. _____ [2]

6b. Describe the features that are common between chromosomes that are homologous. [2]

6c. What is the role of homology in a diploid species? [1]

6d. What is the difference between a gene and an allele? [1]

6e. Write down n , $2n$, $3n$ or $4n$ to show the ploidy level of the following in a sorghum plant. [2]

The leaf ____ The embryo sac ____ The endosperm ____ The root hair ____

6f. Ten microspore mother cells undergo meiosis in maize and a recombination event takes place between gene loci A and b at a frequency of 0.2. How many recombinant pollen grains are produced? Show your working here. [3]

6g. Distinguish between a sporophyte and a gametophyte. [1]

6h. Draw the embryo sac of a maize plant below and label all the essential feature that define its function. [3]

6i. Describe two differences between the processes of mitosis and meiosis. [2]

6j. Two alleles at a gene locus are said to be codominant. Explain what this means giving an example. [2]
