

UNIVERSITY OF RUHUNA

BACHELOR OF SCIENCE (GENERAL) DEGREE LEVEL III SEMESTER I

EXAMINATION –OCTOBER 2023

Subject: Botany

Course Unit: BOT1212 (Genetics)

Time: 2 hours

Index NO.:

Answer **ONLY 04** questions including **both** questions in **PART A (Q1 and Q2)**

Part A

Answer both questions No. 1 and 2

(I) Select and underline the most appropriate answer from *a, b, c* and *d*

(80 marks)

- I. The number of Autosomes in the human genome is
 - a) 46
 - b) 23
 - c) 02
 - d) 44
- II. Genes are located in of organisms
 - a) Nucleus
 - b) Cytoplasm
 - c) Chromosomes
 - d) Nucleic acids
- III. In any species the complete diploid set of chromosomes is referred to as the
 - a) autosomes
 - b) Karyotype
 - c) Heterozygotes
 - d) Genome
- IV. In pea plants, tall pea plants (T) are dominant over short pea plants (t). Which of the following are genotypes of F1 generation if the dominant homozygote crossed with heterozygote?
 - a) TT and Tt
 - b) TT, Tt and tt
 - c) TT only
 - d) tt and TT

- V. If an organism's somatic cells have 36 chromosomes, how many chromosomes do their gametes have?
- 36
 - 18
 - 72
 - None of above
- VI. If the allele frequency of a population remains unchanged from generation to generation, which of the following criterion/criteria must be fulfilled?
- Random mating
 - Large population size
 - Gene flow among population
 - Only *a* and *b*
- VII. Which of the following phenotype ratio is the result of inheritance of lethal genes?
- 9:3:3:1
 - 1:2:1
 - 3: 1
 - 1: 2 or 2:1
- VIII. The scientists who described the first gene linkage would be
- Watson, Crick, Kery Mullis
 - Kimura, Mendel , Fisher
 - Sutton, Bateson & Punnet, Morgan
 - Garber, Poisson, Morgan
- IX. The correct statement about the data of unordered tetrads would be
- Determine the segregation patterns during meiosis.
 - Determine the parental types, non-parental ditypes, and tetratypes
 - Determine the distance between the gene and the centromere.
 - Both a and c
- X. The correct statement about the R plasmids is the plasmids that would be
- Have an effect on the production of bacterial toxins.
 - Have the effect on resistance to antibiotics.
 - Have control over structural components of pathogenic bacteria.
 - None of the above.
- XI. Which of the following terms describes bacteriophage DNA that has become integrated into the host cell?
- Intemperate bacteriophages
 - Transposons
 - Prophages
 - T-even phages
- XII. Which
- Aft
 - fac
 - Mo
 - TH
 - Co
 - th
- XIII. In a l
- woul
 - a) 9
 - b) 4
 - c)
 - d)
- XIV. In
- ge

- XII. Which of the following statements describes the lysogenic cycle of lambda (λ) phage?
- a) After infection, the viral genes immediately turn the host cell into a lambda-producing factory, and the host cell then lyses.
 - b) Most of the prophage genes are activated by the product of a particular prophage gene.
 - c) The phage genome replicates along with the host genome.
 - d) Certain environmental triggers can cause the phage to exit the host genome, switching from the lytic to the lysogenic.

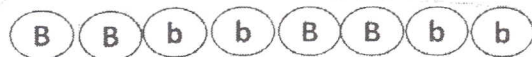
- XIII. In a *Neurospora* strain, the loci A/a and D/d are 10 map units apart. In a cross, Ad X aD, what would be the proportion of each of the following progeny classes of Ad and recombinants.
- a) 90% and 10% respectively
 - b) 45% and 10% respectively
 - c) 90% and 5% respectively
 - d) 45% and 5% respectively

- XIV. In *Neurospora*, a cross between the genotypes B and b results in an ascus with ascospores of genotypes as shown below:

A, B, C, and D are events that take place during meiosis.

- A. Crossing over between the centromere and the gene
- B. Segregation of alleles B and b in meiosis I.
- C. Segregation of the alleles B and b in meiosis II
- D. Assortment of alleles B and b.

Which of the above events could correctly explain the observation shown in the figure?



- a) A followed by C
- b) C only
- c) A followed by B
- d) D only

XV. The genetic disorder/s caused by the change of chromosome number would be

- a) Klinefelter syndrome
- b) Down syndrome
- c) Turner syndrome
- d) above all

(2)

i. Identify the following diagram and label A to E

(12 marks)

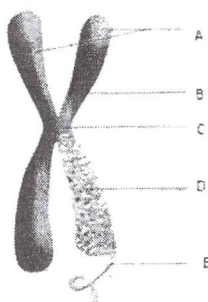
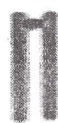


Diagram:.....

A:.....
 B:.....
 C:.....
 D:.....
 E:.....

ii. Chromosomes are named based on the centromere position shown below. Give scientific names for A-D (12 marks)



A.....B.....C.....D.....

iii. Mendel used different true-breeding (pure bred) pea plants for his experiments. What are the reasons for use of pea plants? (15 marks)

.....

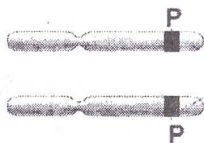
.....

.....

.....

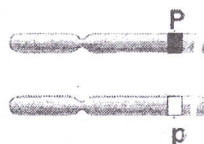
.....

iv. Name following chromosomes as homozygous and heterozygous (06 marks)



}

A:.....



}

B:.....

v. A population has individuals of phenotype AA 224, Aa 70 and aa 06.

a) What are the genotype frequencies of AA, Aa and aa? (09 marks)

b) Calculate the allelic frequency of "A" and "a" alleles (12 marks)

vi. Give three genetic disorders caused by the sex-linked genes

(06 marks)

vii. Distinguish between the following terms.

a. Linear descent and horizontal gene transfer in bacteria

(08 marks)

b. Lytic and lysogenic cycle in phage

(08 marks)

c. Transformation and transduction

(08 marks)

(06 marks)

viii. List two (4) differences between mitosis and binary fission

(12 marks)

ix. Briefly describe the F' conjugation in bacteria.

(15 marks)

(08 marks)

x. Mention five phenotypic changes that can be used to identify virus mutants.

(05 marks)

(08 marks)

(08 marks)

xi. List the differences between virulent and temperate phages.

(12 marks)

PART B

Answer **only two** questions from part B.

(3)

- i) Write the major **FOUR** stages of cell division in eukaryotes and mention the main role of each stage (20 marks)

- ii) Define linked genes and explain briefly the inheritance of the linked genes. (20 marks)

iii) When an individual carrying heterozygous alleles for three genes (Aa, Nn, and Rr) is mated with a parent that is homozygous recessive for all three genes (aa, nn, and rr), the resulting offspring exhibit various phenotypes, as described by the following frequency distribution.

1. ANR	347
2. anr	357
3. ANr	52
4. anR	49
5. Anr	90
6. aNR	92
7. AnR	6
8. aNr	7
Total	1000

- a) What are the parental and recombinant phenotypes of progeny? (10 marks)
 - b) Determine the map distance between A and N, N and R and A and R (30marks)
 - c) Which gene occupies the central position in this genetic scenario, and what is the reason for your answer? (10 marks)
 - d) Illustrate the gene map of A, N and R genes (10 marks)
- (100 marks)

4)

- a. Briefly explain five (5) significant advantages of fungi as a model organism in genetics. (20 marks)
- b. A Neurospora strain that carries two mutant genes (a and b) was crossed with the wild type. After the cross in which these genes were segregating, the following ordered spore arrangements were found in the frequencies noted. (80 marks)

1	2	3	4	5	6
a b	a b	a b	a b	a +	a +
a b	a +	+ b	+ +	a +	+ +
+ +	+ b	+ +	+ b	+ b	a b
+ +	+ +	a +	a +	+ b	+ b
58	14	15	2	1	10

Calculate the distance between the genes a & b and the distance of each gene to the centromere. Illustrate the distance between the genes using a genetic map.

(Total 100 marks)

- 5) Write short notes on any three of the following
 - a) Lethal genes and their inheritance
 - b) Chromosome mutations
 - c) High-frequency recombination (Hfr) cell conjugation in bacteria
 - d) Recombination methods in viruses.

(Total 100 marks)

@@@@@@@@@@@@ @@@@@@@@@@@@@@@@@@@@@@@@@@@@@