University of Ruhuna - Faculty of Technology
Bachelor of Biosystems Technology Honours Degree
Level 1 (Semester II) Examination
Academic Year 2020/2021
November/December - 2022

Course Unit: BST 1251 - Fundamental Genetics (Theory)
Time allowed: 1 hour and 30 minutes

Index No: ....

INSTRUCTIONS:
Number of pages: Six (06)
Write your **index number** in the space provided.
Part I - Answer **all** questions.
Write the answer in the space given for each question.
Time allocation: 1 hour.
Part II - Answer **one (01)** question only.
Time allocation: 30 minutes.

Part I

1. **(20 minutes) [100 marks]**

a. The base sequence of the sense strand of a normal DNA fragment and three mutated sequences are given below.

    Normal DNA: A C T G A G C T A

    Mutation 1:   A C T G G A G C T A

    Mutation 2:   A C T A G C T A

    Mutation 3:   A C T T A G C T A

i. Name the bases represented by A, C, T, and G.   (8 marks)

   A..

   C..

   T..

   G..

ii. Describe the mutations 1, 2, and 3.   (15 marks)

   Mutation   1:..

   ....

   Mutation   2:..

   ....

   Mutation   3:..

   ....

b. The protein 'globin' of hemoglobin contains two types of the polypeptide chain. In sufferers of sickle-cell anemia one type of polypeptide chain contains an amino acid that differs from the normal. This is due to a DNA mutation that produces the base sequence CAT instead of CTT.

i. Name two (2) mutagenic agents. (20 marks)

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ii. Give the type of gene mutation resulting in sickle-cell anemia? (10 marks)

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iii. Explain why the mutation resulted in only one amino acid of the affected polypeptide chain. (15 marks)

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c. The figure (a) shows the norms of reactions of genotypes 1 and 2.
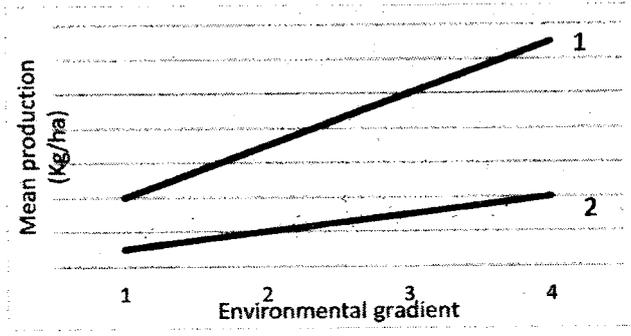
Figure a

i. Describe two (02) observations of the above figure (a). (10 marks)

1. ....

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2. ....

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ii. Draw the graph for an environment where gene-by-environment interaction does not exist for genotypes 1 and 2. (12 marks)

iii. Gene-environment interactions can result in different disease phenotypes. Give an example from humans. (10 marks)

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2. (20 minutes) [100 marks]

a. Approximately one animal in 10,000 is born with floppy ears in a rabbit population that is expressed in individuals homozygous for the recessive allele (aa). Assume that the population is under Hardy-Weinberg equilibrium.

i. Calculate the frequency of the recessive allele in the population. (15 marks)

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ii. Calculate the frequency of the dominant allele. (10 marks)

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iii. Calculate the percentage of carriers of the trait within the population. (20 marks)

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b. For a series of breeding experiments, a linkage group composed of genes A, B, C, and D was found to show the following gene combinations. (All recombinations are expressed per 100 fertilized eggs).

Genes	A	B	C	D
A	-	12	15	4
B	12	-	3	8
C	15	3	-	11
D	4	8	11	-

i. Construct a genetic map for genes A, B,, C and D. (20 marks)

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ii. A genetic map is not very informative. Give two (2) reasons to support the above statement. (10 marks)

1...

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2...

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iii. Define the term 'pleiotropy'. (10 marks)

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iv. Give an example of pleiotropy. (15 marks)

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3. (20 minutes) [100 marks]

a. What is Genetic Recombination? (10 marks)

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b. Name three (3) biological roles of genetic recombination. (12 marks)

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c. Describe the copy choice mechanism of genetic recombination. (10 marks)

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d. Draw and describe the replicative genetic recombination. (20 marks)

Draw:
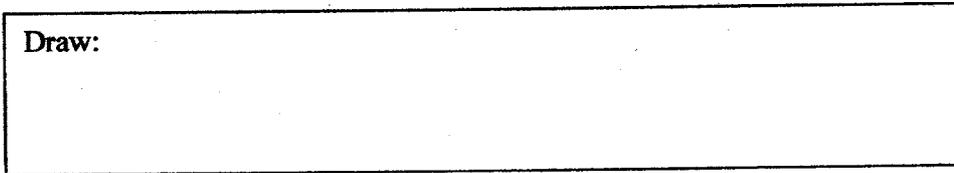
Description:

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e. List two (2) key features of each of the below-mentioned recombination processes.
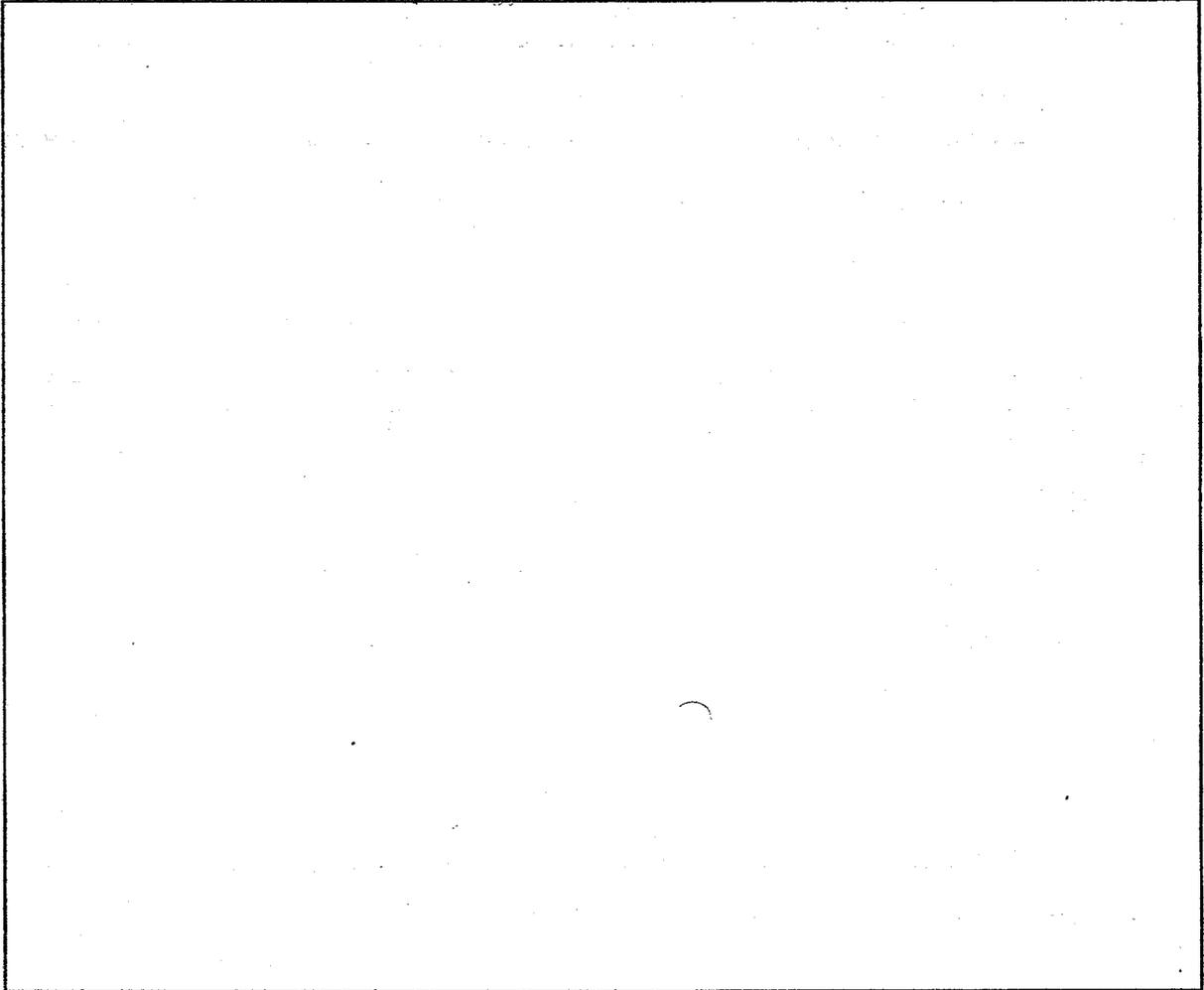
Transformation (10 marks)

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Transduction (10 marks)

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Conjugation (10 marks)

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f. Briefly explain the steps of the conjugation process using a labeled diagram. (18 marks)

Answer only one (1) question. (30 minutes) [100 marks]

1) I) Describe the gene expression process using diagrams where applicable.

(100 marks)

2) I) Define "Bioinformatics". (10 marks)

II) Distinguish between primary and secondary biological databases giving one example for each category. (30 marks)

III) Giving examples, briefly explain the applications of bioinformatics in the current world. (60 marks)

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