INDRAPRASTHA INSTITUTE *of* INFORMATION TECHNOLOGY **DELHI**

Mid Semester Exam
Instructor: Dr. Gaurav Ahuja
Subject: Genetics and Molecular Biology
Year: 2021
Date of Exam: 2-Nov-2021

Instructions:

1. All three questions carry equal marks.
2. No Negative Marking
3. Marks will be given for propagating novel ideas, rather than textbook knowledge.
4. No answers will be accepted after 11 pm (Strict deadline).

Question 1: A Eukaryotic Cell can get mutations that hamper its DNA. Mutations in the genome impair the transcribed messenger RNA and subsequently the protein it encodes. Of note, alterations in cellular function are mainly due to defunct protein that might comprise its activity or function, therefore, could lead to loss or gain of function. Recent evidence suggests that in a cell a mutated protein can be formed despite it having intact (non-mutated) RNA and DNA. How can such mutated proteins appear? Does it mean that the central dogma of molecular biology is still incomplete? Let's assume you find the potential reason for such mutated proteins, how can we rectify such alterations?
(This question may have more than one answer. Think of all the possibilities and describe them all.)

Question 2: A student has performed a fluctuation assay to test two of her compounds for mutagenesis. She believes her two selected chemicals A and B possess mutagenesis function. To solve this, she performed fluctuation assay on wild-type yeast. She incubated wild-type yeast with the chemical A and B in 40 replicates each and selected for canavanine mutants (mutants that grow in the presence of canavanine; since non-mutants i.e. the wild-type normally die). The experiment was performed in 40 biological replicates for both A and B, and the results table that contains the number of mutants per sample (treated and untreated) is given in the following link?
Since some mutants are also present in the untreated samples, and some treated samples are negative for any mutants, how can she analyze such data? Can she conclude that the chemicals A and B can induce mutations? Let's say, she does not have canavanine in her lab, and she selects for another selection method (temperature-sensitive mutants), do the results i.e. mutation rate will vary? Link to the data:

https://docs.google.com/spreadsheets/d/1wjkNyt5lfwf-QtlNedBqvRJNwLnIlM8wQf1cWVn8XMg/edit?usp=sharing

(This question may have more than one answer. Think of all the possibilities and describe them all.)

Question 3: In humans, the ABO blood groups are controlled by three alleles (only two of which occur in any one individual): the alleles for A and B type blood are co-dominant towards each other, and both are dominant to the allele for O type blood.
a. If a person with type AB blood marries someone with type O blood, what are the possible phenotypes of their offspring?

In the following, determine the genotypes of the parents:

b. One parent has type A and the other has type B, but all four blood groups are represented in the children.
c. One parent has type AB and the other has type B, but of the children, 1/4 have type A, 1/4 have type AB, and 1/2 have type B.

=> In the following cases of disputed paternity, determine the probable parent.
a. Mother is type B, child is type O. Father #1 is A; father #2 is AB.
b. Mother is type B, child is type AB. Father #1 is A; father #2 is B.

=> A woman with type A blood has parents who are both type AB and a husband who is a type B. What is the probability that their first child will be a son with type O blood?