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## BRAINWARE UNIVERSITY

Term End Examination 2024-2025

Programme – B.Sc.(BT)-Hons-2023

Course Name – Genetics

Course Code - BBT40113

( Semester IV )

Full Marks : 60

Time : 2:30 Hours

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

### Group-A

(Multiple Choice Type Question)

1 x 15=15

1. Choose the correct alternative from the following :

- (i) Indicate the term that refers to both the process of change in genetic material and the resulting organism with a novel phenotype
  - a) Variation
  - b) Mutation
  - c) Adaptation
  - d) Recombination
- (ii) Identify which of the following best describes a Cot curve?
  - a) A graph representing the rate of DNA renaturation over time
  - b) A graph showing the concentration of DNA over a range of temperatures
  - c) A graph depicting the rate of DNA denaturation at different salt concentrations
  - d) A graph illustrating the relationship between DNA concentration and time during hybridization
- (iii) Predict the typical pattern of inheritance for X-linked dominant traits
  - a) Only expressed in males
  - b) Expressed in heterozygous females and all males
  - c) Expressed only in homozygous males and females
  - d) Only expressed in females
- (iv) Predict how dosage compensation is achieved in mammals
  - a) By decreasing transcriptional activity of X chromosome genes in females
  - b) By increasing transcriptional activity of X chromosome genes in males
  - c) By decreasing transcriptional activity of Y chromosome genes in males
  - d) By decreasing transcriptional activity of Y chromosome genes in females
- (v) Identify which of the following is NOT an example of an imprinted gene
  - a) IGF2
  - b) CDKN1C
  - c) SNRPN
  - d) BRCA1
- (vi) Recall which of the following is NOT a type of natural selection
  - a) Directional selection
  - b) Stabilizing selection
  - c) Disruptive selection
  - d) Random selection

- (vii) Recall the primary purpose of eugenics
- Enhancement of human qualities through selective breeding
  - Preservation of genetic diversity
  - Prevention of genetic disorders
  - Promotion of random mating
- (viii) Identify the primary concern associated with the bottleneck effect.
- Loss of genetic variation
  - Increase in genetic diversity
  - Elimination of deleterious alleles
  - Preservation of rare alleles
- (ix) Illustrate a sex-linked inheritance pattern with the correct example.
- Hemophilia inheritance on X chromosome
  - Blood type inheritance.
  - Eye color inheritance.
  - Height inheritance.
- (x) Infer the function of tandem repeats in the genome.
- Enhance gene expression
  - Maintain chromosome structure
  - Regulate DNA replication
  - Encode specific proteins
- (xi) Predict the condition characterized by an abnormal number of chromosomes, commonly associated with disorders such as Down syndrome and Turner syndrome.
- Trisomy
  - Tetraploidy
  - Monosomy
  - Aneuploidy
- (xii) Name the physical basis of the principle of segregation in genetics.
- Crossing over during meiosis
  - The first division of meiosis, where homologous chromosomes segregate
  - Random assortment of chromosomes during fertilization
  - Independent assortment of alleles on non-homologous chromosomes
- (xiii) Show how does a test cross help determine whether an organism expressing a dominant trait is a homozygote or a heterozygote.
- By crossing with an organism expressing a recessive trait
  - By observing the phenotypic ratios in the F1 offspring
  - By analyzing the DNA of the offspring
  - By comparing the genotypes of the parents
- (xiv) Choose the definition that best describes the term penetrance.
- The variability in phenotypic expression of a gene
  - The probability of a gene or trait being expressed
  - The presence of multiple alleles at a single locus
  - The ability of an allele to dominate over another allele
- (xv) A rare genetic disorder is inherited in an autosomal dominant manner. A heterozygous affected individual (Aa) marries an unaffected individual (aa). Their first child is affected. If they plan to have a second child, what is the probability that the child will also be affected?
- 100%
  - 75%
  - 50%
  - 25%

### Group-B

(Short Answer Type Questions)

3 x 5=15

(Answer any Five from the following)

- State the definition of allelic and non-allelic interactions with suitable examples. (3)
- Differentiate between euchromatin and heterochromatin in terms of their structure, function, and role in gene expression. (3)
- Predict how UV rays can induce mutations. (3)
- Give at least 2 examples of extranuclear genomes. (3)
- In a population of flowers, 16% are red (RR), 48% are pink (Rr), and the rest are white (rr). Calculate the allele frequencies of the population. (3)

OR

In a population of insects, the frequency of the recessive allele (b) is 0.2. Calculate the percentage of individuals that are heterozygous (Bb). (3)



**Group-C**

(Long Answer Type Questions)  
(Answer any Six from the following)

5 x 6=30

7. If the progeny of the cross aaBB x AAbb is testcrossed, and the following genotypes are observed among the progeny of the testcross, evaluate what is the frequency of recombination between these loci? AaBb 135 Aabb 430 aaBb 390 aabb 120 (5)
8. Describe the structural features and functions of tandem repeats within DNA, and explain their significance in molecular genetics. (5)
9. Produce a detailed account of chromosomal aberrations. (5)
10. Discuss the genetic organization of prokaryotic and viral genomes. (5)
11. Describe the concept of genomic imprinting and its implications in inheritance. How does genomic imprinting result in the differential expression of alleles depending on the parent of origin. (5)
12. Justify how genetic drift could disrupt Hardy-Weinberg equilibrium. Provide an example of a population where genetic drift might play a significant role. (5)

**OR**

Predict the following for a population in the United States, where, approximately one child in 10,000 is born with PKU (phenylketonuria), a syndrome that affects individuals homozygous for the recessive allele (aa). (a) Calculate the frequency of this allele in the population. (b) Calculate the frequency of the normal allele. (c) Calculate the percentage of carriers of the trait within the population. (5)

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