BRAINWARE UNIVERSITY

Term End Examination 2023-2024
Programme – M.Sc.(BT)-2023
Course Name – Genetics
Course Code - MBTE204
(Semester II)

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) Choose which of the following type of chromosomal aberration can lead to disorders such as Cri-du-chat syndrome and Wolf-Hirschhorn syndrome.

a) Duplications
b) Deletions
c) Inversions
d) Translocations

(ii) Select which of the following best describes the principle of segregation in genetics.

a) The expression of dominant traits over recessive traits
b) The random distribution of alleles into gametes during meiosis
c) The blending of genetic traits in offspring
d) The inheritance of two copies of each trait from both parents

(iii) Name the physical basis of the principle of segregation in genetics.

a) Crossing over during meiosis
b) The first division of meiosis, where homologous chromosomes segregate
c) Random assortment of chromosomes during fertilization
d) Independent assortment of alleles on non-homologous chromosomes

(iv) Identify the expected outcome when conducting a test cross, where an organism expressing a dominant trait is crossed with a homozygous recessive organism, given that the dominant-expressing organism is a heterozygote:

a) All offspring will exhibit the dominant trait.
b) The F1 offspring will show a 1:1 ratio of heterozygotes and recessive homozygotes.
c) Only recessive traits will be observed in the offspring.
d) The F1 offspring will be homozygous dominant

(v) Show how does a test cross help determine whether an organism expressing a dominant trait is a homozygote or a heterozygote.

a) By crossing with an organism expressing a recessive trait
b) By observing the phenotypic ratios in the F1 offspring
c) By analyzing the DNA of the offspring
d) By comparing the genotypes of the parents

(vi) Choose the definition that best describes the term penetrance.

a) The variability in phenotypic expression of a gene
b) The probability of a gene or trait being expressed
c) The presence of multiple alleles at a single locus
d) The ability of an allele to dominate over another allele

(vii) Predict which of the following statements about penetrance is true.

a) Penetrance can only be expressed quantitatively.
b) Incomplete penetrance means that the gene or trait is expressed in all individuals who have the allele.
c) Penetrance can be influenced by genetic, environmental, and lifestyle factors.
d) Penetrance and expressivity are interchangeable terms

(viii) Select which of the following statements about expressivity is true.

a) Expressivity refers to the probability of a gene or trait being expressed.
b) Variable expressivity means that the gene or trait is expressed in all individuals who have the allele.
c) Environmental factors do not influence expressivity.
d) Marfan syndrome is an example of reduced expressivity.

(ix) Analyze the function of pseudoalleles.

a) They are alleles with the same function but distinct DNA sequences.
b) They result from mutations that do not impact the protein's functionality.
c) They cause variations in phenotypic expression.
d) They are separable only by rare crossing over

(x) Choose the statement that accurately describes the likelihood of daughters being affected in a pedigree displaying X-linked recessive inheritance, given that their mother is a carrier

a) 1
b) 0.75
c) 0.5
d) 0.25

(xi) Select which statistical method is commonly used to analyze quantitative traits.

a) Chi-square test
b) Analysis of variance (ANOVA)
c) Contingency tables
d) Logistic regression

(xii) Predict the primary difference between monozygotic (MZ) and dizygotic (DZ) twins.

a) MZ twins share 50% of their segregating genes, while DZ twins share 100%.
b) MZ twins share virtually identical genetic material, while DZ twins share only half.
c) MZ twins arise from the fertilization of two separate eggs, while DZ twins arise from a single fertilized egg.
d) MZ twins are always of the same sex, while DZ twins can be of different sexes.

(xiii) Select which mechanism ensures the even distribution of plasmids between daughter cells during cell division.

a) Antibiotic resistance genes
b) Toxin-antitoxin systems
c) Plasmid partitioning systems
d) Stress response mechanism

(xiv) Select which factor influences plasmid maintenance, stability, and evolution within bacterial populations.

a) Plasmid partitioning
b) Plasmid compatibility
c) Toxin-antitoxin systems
d) Stress response mechanisms

(xv) Identify which of the following statements about M13 bacteriophage is true.

a) It has a linear double-stranded DNA genome
b) Its genome codes for a total of 15 genes.

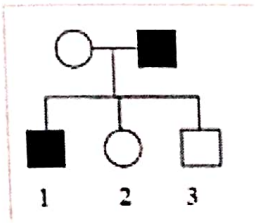
c) Gene VIII codes for the minor coat protein.

d) M13 infection occurs through the binding of its major coat protein to bacterial sex pili.

Group-B

(Short Answer Type Questions) 3 x 5=15

2. Describe how do bacteria transfer genetic material through conjugation. (3)
3. Differentiate natural and artificial competence in bacterial transformation (3)
4. Discuss the concept of transposon tagging and its significance in gene cloning. (3)
5. Propose the concept of adhesion molecules and explain its role in genetics. (3)
6. Predict the modes of inheritance that are consistent with this pedigree. (3)



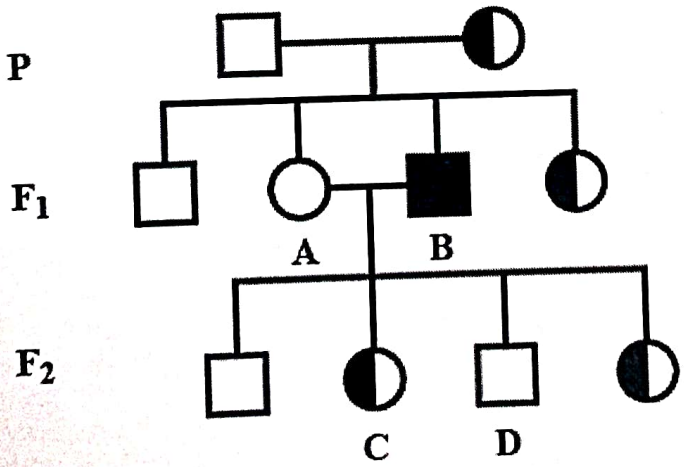
OR

Justify and explain how many Barr bodies would you expect to find in humans with the following abnormal compositions of sex chromosomes. A. XXY B. XYY C. XXX D. X0 (a person with just a single chromosome). (3)

Group-C

(Long Answer Type Questions) 5 x 6=30

7. Briefly describe the three main mechanisms of horizontal gene transfer in bacteria. (5)
8. Explain the underlying mechanism that dictates the selection between the lytic and lysogenic cycles in bacteriophages. (5)
9. Study the given pedigree chart showing the inheritance of an X-linked trait controlled by gene r. What will be the genotypes of individuals A, B, C, and D respectively? (5)



10. Generalize the structure and function of MHC class I and class II molecules, highlighting their respective roles in antigen presentation and immune response activation. (5)

11. Hypothesize the impact of multiple alleles on the genetic diversity within a population, discussing how the presence of multiple alleles at a single locus affects evolutionary processes and adaptation. (5)

12. Justift the mechanisms of cell division errors, including failures during mitosis and cytokinesis. How do these errors contribute to aneuploidy and chromosomal instability, potentially leading to cancer development. (5)

OR

Write the role of chromosomal rearrangements, such as deletions, duplications, inversions, and translocations, in human genetic disorders. How do these structural changes contribute to disease phenotypes? (5)

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