

**GENETICS
(BIOT 3101)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

**Group – A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) The term 'Dosage compensation' refers to
(a) Polyploidy (b) X chromosome inactivation
(c) Epistasis (d) Linkage.
- (ii) Crossing over in diploid organisms is responsible for
(a) Dominance of genes
(b) Segregation of alleles
(c) Recombination between linked genes
(d) Linkage between genes
- (iii) If an X-linked recessive disorder is in Hardy-Weinberg equilibrium and the incidence in males equals 1 in 100, then the expected incidence of affected homozygous females would be _____.
(a) 1 in 1000 (b) 1 in 4000
(c) 1 in 10,000 (d) 1 in 40,000.
- (iv) AB blood group is an example of
(a) Incomplete dominance (b) Co-dominance
(c) Lethal alleles (d) Mendelian inheritance.
- (v) An interaction between non-allelic genes in which an allele at one locus prevents expression of an allele at another locus, but not vice versa, is called
(a) Collaboration (b) Complementation
(c) Epistasis (d) Modification.
- (vi) The first retroviral oncogene discovered by Peyton Rous was
(a) rsv (b) src
(c) ras (d) raf.

- (vii) Consanguinity shows a strong association with which pattern of inheritance?
(a) Sex-linked dominant (b) Sex-linked recessive
(c) Autosomal dominant (d) Autosomal recessive.
- (viii) Which of the following is NOT a measure of central tendency?
(a) Mean (b) Mode
(c) Range (d) Median.
- (ix) _____ refers to the study of events which are going to happen or not.
(a) probability (b) correlation
(c) regression (d) Chi square analysis.
- (x) Which statistical test would be best to determine in wing length of butterfly from five different places?
(a) F test (b) Student's t-test
(c) Regression analysis (d) Chi-square test.

Group – B

2. (a) Singed bristles (sn), crossveinless wings (cv) and vermilion (v) eye colour are due to recessive mutant alleles of the 3 sex-linked genes in *Drosophila melanogaster*. When a female heterozygous for each of the 3 genes was test-crossed with a singed, crossveinless, vermilion male, the following progeny were obtained:
singed, crossveinless, vermilion – 3
crossveinless, vermilion – 392
vermilion – 34
crossveinless – 61
singed, crossveinless – 32
singed, vermilion – 65
singed – 410
wild type – 3
(i) What is the correct order of the 3 genes on the chromosome?
(ii) What are the genetic map distances between the 3 genes?
(iii) Calculate the coefficient of coincidence.
- (b) Joe is color blind. Both his mother and his father have normal vision, but his mother's father (Joe's maternal grandfather) is color blind. All Joe's other grandparents have normal color vision. Joe has three sisters Patty, Betsy, and Lora - all with normal color vision. Joe's oldest sister, Patty, is married to a man with normal color vision; they have two children, a 9 -year-old color-blind boy and a 4 -year-old girl with normal color vision.
(i) Using standard symbols and labels, draw a pedigree of Joe's family
(ii) What is the most likely mode of inheritance for color blindness in Joe's family?
(iii) If Joe marries a woman who has no family history of color blindness, what is the probability that their first child will be a color-blind boy?

- (iv) If Patty and her husband have another child, what is the probability that the child will be a color-blind boy?

$$(2 + 2 + 1) + (2 + 1 + 2 + 2) = 12$$

3. (a) Vermilion eye colour in *Drosophila* is determined by the recessive allele *v*; the wild type eye colour produced by the *v*⁺ allele is brick red. What phenotypic ratios are expected from the crosses:
- (i) vermilion female with wild type male
 - (ii) homozygous wild type female with vermilion male
 - (iii) heterozygous female with vermilion male.
- (b) Briefly describe any one type of structural chromosomal aberration with a diagram.
- (c) Explain with a diagram the salient features of a Polytene chromosome.

$$(2 + 2 + 2) + 3 + 3 = 12$$

Group – C

4. (a) What are the unique properties of cancerous cell?
- (b) Discuss with an example that carcinogenesis is a multi-step, multi-mutation process.
- (c) Explain with diagram how a mutation in the *Rb* gene leads to tumour formation.
5. (a) Explain how Tautomerization leads to anomalous base pairing of DNA.
- (b) How are Apurinic sites formed?
- (c) Discuss with an example the process of Frameshift mutation.

$$4 + 4 + 4 = 12$$

$$4 + 4 + 4 = 12$$

Group – D

6. (a) Give a comparative account of generalized and specialized transduction with illustrations.
- (b) In *E. coli* four Hfr strain donate the following genetic markers shown in the order denoted:

Strain 1	Q	W	D	M	T
Strain 2	A	X	P	T	M
Strain 3	B	N	C	A	X
Strain 4	B	Q	W	D	M

All these Hfr strains are derived from the same F⁺ strain. What is the order of these markers on the chromosome of the original F⁺?

- (c) Write a brief note on *Hfr* conjugation with illustrations.

$$4 + 4 + 4 = 12$$

7. (a) Discuss the interrupted mating technique devised by Wollman and Jacob to establish bacterial gene mapping.
- (b) Describe the role of maternal effect genes in *Drosophila* development.
- (c) How do mitochondrial mutations affect cellular ageing?

4 + 4 + 4 = 12**Group – E**

8. (a) Prove that allele frequencies remain constant throughout generations in an ideal population.
- (b) Cystic fibrosis, an autosomal recessive trait, has an incidence of about 1/2500. Calculate the frequency of heterozygotes.
- (c) In the evening primrose pure red flowered plants were crossed with white flowered plants, F_1 are all pink coloured. Inbred F_1 plants produced 113 red, 242 pink and 129 white flowered plants. This phenotypic ratio also seems to be genotypic ratio of the F_2 of a Mendelian monohybrid cross involving a gene responsible for flower pigmentation. Analyse the result with suitable statistical test. Given that χ^2 value for 2 *df* at 0.05 is 5.99.

4 + 4 + 4 = 12

9. (a) In a study on patients the following data are obtained. Find the mean and standard deviation.

Age	20-29	30-39	40-49	50-59	60-69	70-79	80-89
Number of cases	1	11	10	17	38	9	3

- (b) A question paper contains 12 questions, divided into three parts. A contains 6 questions; part B and part C contain 3 questions each. A candidate is required to attempt 6 questions selecting at least 3 questions from part A and at least one from each of the parts of B and C. In how many ways can the candidate select his 6 questions?

6 + 6 = 12

Department & Section	Submission Link
BT	https://classroom.google.com/c/MTI3ODc0NTU0MzA1/a/Mjc1NDc1OTQ0NjY5/details