

[This question paper contains 6 printed pages.]

995

Your Roll No.

B.Sc. (Hons.) / III

C

BIOCHEMISTRY – Paper XI

(Molecular Biology – I)

(Admissions of 2000 and onwards)

Time : 3 Hours

Maximum Marks : 60

*(Write your Roll No. on the top immediately
on receipt of this question paper.)*

*Attempt five questions in all, including
Question No. 1 which is compulsory.*

1. (a) Explain the following observations :
- (i) Positively supercoiled DNA does not exist in nature.
 - (ii) T_m of a linear dsDNA decreases in presence of urea.
 - (iii) Multiple cross overs do not give a true picture of the map distance.
 - (iv) Tautomerization is believed to contribute to mutation.

P.T.O.

(v) Recombinational repair is an SOS response.
(2×5=10)

(b) What is the significance of the following in genetic studies :

(i) Auxotrophic mutants

(ii) Petite mutants (1.5×2=3)

(c) Give the functions of the following proteins in DNA replication :

(i) Primase

(ii) PCNA

(iii) β subunit of DNA pol III (3)

2. (a) What do you understand by genomic imprinting ? Explain the molecular mechanisms of Prader-Willi Syndrome and Angelman Syndrome in relation with genomic imprinting. (3)

(b) Albinism is a recessive human trait. What is the probability that a normal couple has two children, one normal and other being albino ? (3)

(c) Explain rolling circle model of replication with a suitable example. In this model, does the newly synthesized strand correspond to the leading strand or the lagging strand in conventional replication ? Explain your answer. (5)

3. (a) What mechanism is believed to be responsible for the expansion of triplet repeat sequences? Name two human diseases known to be caused by such expansion. (3)
- (b) Draw and label the structure of a typical composite transposon in bacteria. How is it different from a non composite transposon? (3)
- (c) A man with a certain genetic disease marries a normal woman. They have eight children (four boys and four girls). All of the girls have their father's disease but none of the boys do. What mode of inheritance is suggested? (2)
- (d) Predict whether the loss of the following *E. coli* genes would be lethal or not. Justify your answer.
(i) dnaB (ii) pol I (iii) recA (3)
4. (a) Differentiate between :
- (i) Maternal effect and Maternal inheritance.
 - (ii) Base excision and Nucleotide excision repair mechanism.
 - (iii) Autopolyploidy and Allopolyploidy.
 - (iv) Specialized and generalized transduction.
- (2.5×4=10)

- (b) A drug inhibits the activity of enzyme inorganic pyrophosphatase. What effect would the drug have on DNA synthesis? (1)
5. (a) Explain the following :
- (i) Complementation test.
 - (ii) Non-disjunction as a proof of chromosomal theory of inheritance.
 - (iii) Molecular mechanism underlying symptoms of xeroderma pigmentosum.
 - (iv) Link between telomeres, cell senescence and cancer.
 - (v) Genetic basis of Bombay phenotype. (2.5×4+1.0=11).
6. (a) If replication occurs at a rate of 1000 bp/sec, how long would it take to replicate *E. coli* chromosome at 37°C with theta replication? (3)
- (b) How does the action and mutagenic effect of 5-Bromouracil differ from that of nitrous acid? (2)
- (c) Differentiate between physical and genetic map distance. (3)
- (d) How can one distinguish between paternal transmission of Y chromosome from transmission from an organelle? (3)

7. (a) Yellow versus gray body color in *D. melanogaster* is determined by the alleles y and y^+ , vermilion versus wildtype eyes by the alleles v and v^+ , and singed versus straight bristles by the alleles sn and sn^+ . When females heterozygous for each of these X-linked genes were testcrossed with yellow, vermilion, singed males, the following classes and numbers of progeny were obtained :

yellow, vermilion, singed	53
yellow, vermilion	108
yellow, singed	331
yellow	5
vermilion, singed	3
vermilion	342
singed	95
wildtype	63

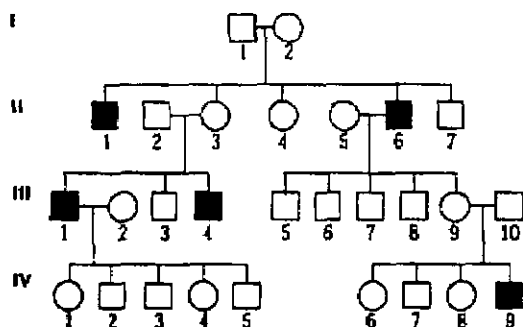
- (i) What is the order of the three genes ?
Construct a linkage map with the genes in their correct order, and indicate the map distances between the genes. (4)

- (ii) Determine the coefficient of coincidence. (1)

- (b) What do you understand by enzyme processivity ?
Explain why this is an important feature of DNA polymerase ? (2)

(c) Explain two ways by which fidelity is maintained during DNA replication. (4)

8. (a) The following pedigree represents the inheritance of a rare disorder in an extended family. What is the most likely mode of inheritance for this disease? (Assume that the trait is fully penetrant.) Justify your answer. (4)



(b) A particular recessive disorder is present in one in forty thousand individuals. If the population is in Hardy Weinberg equilibrium, what are the frequencies of the two alleles? (2)

(c) How does the formation of Holliday intermediates in homologous genetic recombination differ from their formation in site specific recombination? (5)