2015

M.Sc. Part–I Examination

ZOOLOGY

PAPER—II (Group—A)

Full Marks : 50

Time : 2 Hours

The figures in the margin indicate full marks.

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

Illustrate the answers wherever necessary.

Group—A

Answer any *four* questions taking *two* from each unit.

Unit—I

[Cytogenetics]

1. (a) A cross is made between an Hfr that is $met^+ thr^+ pur^+$ and an F^- that is $met^- thi^- pur^-$. Interruptied mating studies show that met^+ enters the recipient last, so that met^+ recombinants in the F^- back ground are selected on a medium containing supplements that

satisfy only the pur and thi requirements. These recombinants^{-} are tested for the presence of the thi^{+} and pur^{+} alleles. The following numbers of individuals are found for each genotype :

1. met^{+} thi^{+} pur^{+} 280
2. met^{+} thi^{+} pur^{-} 0
3. met^{+} thi^{-} pur^{+} 6
4. met^{+} thi^{-} pur^{-} 52

(a) Why was methionine (met) left out of the selection medium ?

(b) What is the gene order ?

(c) What are the map distances in the recombination units ? $2\frac{1}{2}+5+5$

2. (a) Various pairs of r II mutants of phage T4 are tested in *E.coli* in both cis and trans positions. Comparisons are made of 'burst size'. Table shows results for six different r mutants : rM, rN, rO, rP, rR, and rS. If we assign the mutaion ro, to the A cistron, what are the locations of the other five mutations with respect to A and B cistron ?

Result of r II mutant crosses

Cis genotype	*Burst size*	*Trans genotype*	*Bust size*
rM rN/++	245	rM+/rN	250
rO rP/++	256	rO+/+rP	268
rR rS/++	248	rR+/+rS	242
rM rO/++	270	rM+/+rO	0
rM rP/++	255	rM+/+rP	255
rM rR/++	264	rM+/+rR	0
rM rS/++	240	rM+/+rS	240
rN rO/++	257	rN+/+rO	268
rN rP/++	250	rN+/+rP	0
rN rR/++	245	rN+/+rR	255
rN rS/++	259	rN+/+rS	0
rP rR/++	260	rP+/+rR	245
rP rS/++	253	rP+/+rS	0

(b) The following deletion map shows four deletions (1–4) involving the rII A cistron of phage T4 :

1. _____
2. _____
3. _____
4 _____

Five point mutations (a–e) are tested against these tone deletion mutants for their ability to give wild type (r^{+}) recombinants, the results are :

	a	b	c	d	e
1	+	+	+	+	+
2	+	+	+	–	–
3	+	–	+	–	–
4	–	–	+	–	–

What is the order of the point mutation ?

3. (a)

	AA	*Aa*	*aa*
I	0·3	0·0	0·7
II	0·2	0·2	0·6

Which of the above populations are in HW-equilibrium ?

(b) About 70% all white North American can taste phanyl-thiocarbamide & the remainder can not. The ability to taste is determined by the dominant allele T, and the inability to taste is determined by the recessive allele. If the population is assumed to be in HW equilibrium, what are the genotypic and allelic frequencis in this propulation ?

(c) In a generalized transducing phage P.1, the donor is pur^+ nad^+ pdx^- and the receipient is pur^- nad^- pdx^-. The donor allele pur^+ is initially selected after transduction, and 50 pur^+ transductants are then scored for the other alleles present. The result follow :

Genotype	*Number of colonies*
nad^+ pdx^+	3
nad^+pdx^-	10
nad^- pdx^+	24
nad^- pdx^-	13
	50

(i) What is the cotransduction frequency for pur & nad ?

(ii) What is the contransduction frequency for pur & pdx ?

(iii) Which of the unselected loci is closest to pur ?

$3+3+6\frac{1}{2}$

4. (a) Mention the role of Ras protein in a signaling cascade with proper diagram.

(b) What happens when a cell containing two mutant rb alleles ?

(c) How does G_1 arrest take place when DNA damage occurs ?

$4+4+4\frac{1}{2}$

Unit—II

[Molecular Biology]

5. (a) What is the key to the high processivity of the DNA polymerase ?

(b) State the features of the "trombone" model for coordinating replication by two DNA polymerases at the *E.coli* replication fork with diagram.

(c) What is meant by polymerase switching ?

$4+5+3\frac{1}{2}$

6. (a) How does termination occur in *E.coli* translation ?

(b) State the role of elongation factor, EF – G in *E.coli.*

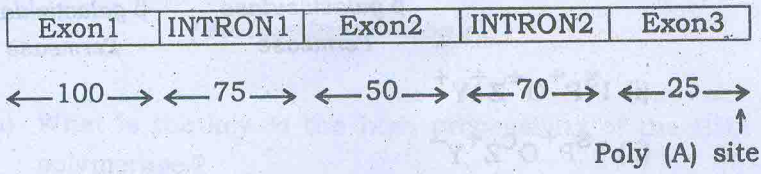
(c) What is the role of initiation factor IF 1 and IF 3 in bacteria ?

7. (a) This question involves the lac operon of *E.coli* where I = repressor gene, P = promoter gene O = operator gene Z = β galaetosidase gene Y = permease gene. Complete Table below using + to indicate that the enzyme will be synthesized and – to indicate that enzyme will not be synthesized :

Genotype	*Inducer absent*	*Inducer present*
	β galactosidase Permease	*β galactizidase Permease*
(i) $I^{S}P^{+}O^{+}Z^{+}Y^{+}$		
(ii) $I^{S}P^{+}O^{C}Z^{+}Y^{-}$		
(iii) $I^{-d}P^{+}O^{+}Z^{+}Y^{+}$		
(iv) $I^{S}P^{+}O^{+}Z^{+}Y^{+}$ / $I^{+}P^{+}O^{C}Z^{+}Y^{-}$		
(v) $I^{-d}P^{+}O^{+}Z^{+}Y^{+}$ / $I^{+}P^{+}O^{+}Z^{-}Y^{+}$		

(b) In presence of high intracelluar concentration of tryptophan, only short transcripts of the trp operon are synthesized because of attenuation of transcription to the structural genes. This is mediated by the recognition of two Trp codons in the leader sequence. What effect would mutating these two codons to UAG stop codons have on the regulation of the operon in the presence or absence of tryptophan ? Explain.

8. (a) The following figure shows the transcribed region of a typical enkaryotic protein-coding gene :



What is the size (in bases) of the fully processed, matured m RNA?

Assume a poly (A) tail of 200 as in your calculation.

(b) How does Rho dependent termination occur in bacteria ?

(c) Match each term (1–4) with its corresponding description (s) in a–g, noting both that each term may have more than one description & each description may apply to more than one term

1. Eukaryotic m RNA s
2. Prokaryotic m RNA s
3. Transfer RNA s
4. Ribosomal RNA s

a. — have a cloverleaf structure.

b. — are synthesized by RNA polymerases.

c. — display one anticodon each.

d. — are the template of genetic information during translation.

e. — contain exon & intron.

f. — are the four types in eukaryotes & only three types in *E.coli.*

g.— are capped on their 5′ end & polyadenylated on their 3′ end. 6

———