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① Total number of printed pages-24

14 (ZOO-3) 3056

2019

ZOOLOGY

Paper : ZOO-3056

Full Marks : 60

Time : Three hours

*The figures in the margin indicate
full marks for the questions.*

Contd.

1. Answer **any twenty** questions from the following :

1×20=20

Choose the correct answer :

(A) Integration of phage genome into bacterial genome normally involves :

- (a) Homologous Recombination
- (b) Site-specific Recombination
- (c) Transposition
- (d) None of the above.

(B) Ds chromosome 9 is :

- (a) Protein Complex involved in Holiday migration
- (b) Proteins involved in site specific recombination in bacteria
- (c) Transposable element associated with kernel colour of corn
- (d) A gene encode protein involves in non-homologous recombination.

(C) The sequence of events of Holiday model of DNA crossover are :

- (i) Formation of heteroduplex region by branch migration
- (ii) Pairing of two homologous DNA molecules
- (iii) Resolution of the Holiday mode
- (iv) Cuts in one strand of both DNAs
- (v) Cut strands of DNA from Holiday structures.

Find out the correct answer :

(a) i, ii, iii, iv, v

(b) ii, iv, v, i, iii

(c) ii, i, iv, v, iii

(d) v, i, ii, iv, iii

(D) Peptidoglycan synthesis during bacterial cell division is carried out by —

- (a) FtsZ
- (b) FtsI
- (c) FtsW
- (d) Both (b) and (c).

(E) Which of the following statements is *True* for a microbial population in exponential growth phase?

- (a) Number of cells double during a constant time interval
- (b) One obtains a curve with constantly increasing slope
- (c) The population increase is in geometric progression of 2
- (d) All of the above.

(F) Down's syndrome is characterized by :

- (a) 19 trisomy
- (b) 21 trisomy
- (c) Only one X chromosome
- (d) two X and one Y chromosome.

(G) In a family, father is having a disease and mother is normal. The disease is inherited to only daughter and to the sons. What type of disease is this?

- (a) Sex-linked dominant
- (b) Sex-linked recessive
- (c) Autosomal dominant
- (d) Autosomal recessive.

(H) Heterokaryon is produced in which type of gene mapping methods?

- (a) Genetic mapping
- (b) Somatic cell hybridization
- (c) Physical mapping
- (d) Linkage mapping.

(I) The area of allowed regions in the Ramachandran map will be least for :

- (a) Glycine
- (b) L-Alanine
- (c) L-Proline
- (d) Alpha-methyl-L-valine.

(J) On the molar scale, which of the following interactions in a non-polar environment provides highest contribution to the biomolecules ?

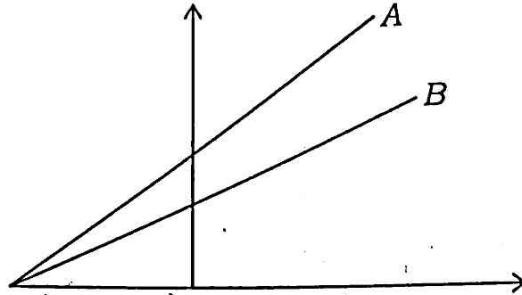
- (a) Van der Waals interaction
- (b) Hydrogen bonding
- (c) Salt bridge.
- (d) Hydrophobic interaction.

(K) Which of the following interactions play a major role in stabilizing B-DNA ?

- (a) Hydrogen bonding
- (b) Hydrophobic interactions
- (c) Van der Waals interaction
- (d) Ionic interaction.

- (L) In a linkage map, two genes A and B are 70cM apart. If individual's heterozygous for both the genes are test crossed number of progeny with parental phenotype will be —
- equal to the number of progeny with recombinant phenotype
 - more than number of progeny with recombinant phenotype
 - less than number of progeny with recombinant phenotype
 - could be more or less than the number of progeny with recombinant phenotype depending on whether the genes are linked in *cis* or *trans* respectively.
- (M) A woman with one gene for haemophilia and one gene for colour blindness on one of the X chromosome marries a normal man. How will the progeny be?
- Haemophilic and colour blind daughters
 - All sons and daughters are haemophilic and colour blind
 - 50% haemophilic and colour blind sons and 50% normal sons
 - 50% haemophilic colour blind sons and 50% colour blind daughters.
- (N) Ligand binding stimulates the formation of dimeric receptors in —
- Tyrosine kinase receptor
 - G protein-coupled receptor
 - Ion channel receptor
 - Intrinsic enzymatic activity.
- (O) Tetrad analysis confirmed the occurrence of crossing-over during tetrad stage. This was first reported in —
- | | |
|--------------------------|------------------|
| (a) Neurospora | (b) E. Coli |
| (c) <i>Pisum sativum</i> | (d) Arabidopsis. |
- (P) If you mix equal volumes of two buffers at pH 6 and pH 8 of identical ionic strength; what will be the resultant pH of the mixture?
- | | |
|-----------|-----------|
| (a) 7 | (b) ~ 8.3 |
| (c) ~ 6.3 | (d) ~ 14 |

- (Q) An inhibitor of a phosphatase called Zyto was added to a reaction at 1mM concentration, at the point when the zyto's substrate was 5mM , two Lineweaver-Burk plot have been made, one with inhibitor and one without inhibitor.



What are the X and Y axes and which of the lines in the plot of the inhibited enzyme kinetics?

(a) $X: \frac{1}{S}$ $Y: \frac{1}{V_{max}} B$

(b) $X: \frac{1}{V}$ $Y: \frac{1}{V_{max}} A$

(c) $X: \frac{1}{V}$ $Y: \frac{1}{S} B$

(d) $X: \frac{1}{S}$ $Y: \frac{1}{S} A$

(R) The G-bands are richer in —

(a) Adenine — Thymine

(b) Cytosine — Guanine

(c) Cytosine — Thymine

(d) Adenine — Guanine.

- (S) Which drug blocks the De-novo pathway of DNA synthesis in somatic cell hybridization ?
- (a) Aminopterin
 - (b) Hypoxanthine
 - (c) Polyethylene glycol
 - (d) Ethylene.
- (T) Haemophilia is a sex-linked recessive trait in humans. If a father and a son are both haemophiliacs, but the mother is normal, her genotype must be
- (a) X^hX^h
 - (b) X^HX^h
 - (c) X^HX^H
 - (d) X^hY .
- (U) The phenomenon of genetic drift is most likely to occur in population —
- (a) when it is small and inbreeding
 - (b) when it is undergoing gene flow
 - (c) when it is allopatric species
 - (d) when it is large and panmictic population.
- (V) The Hardy-Weinberg law describes :
- (a) Genotype frequencies of a population when evolutionary forces are not acting
 - (b) How sexual reproduction would change the relative gene frequencies in a population
 - (c) How mutation occur and balance each other
 - (d) Genotype frequencies of a population when evolutionary forces are acting.

(W) Deviation from Hardy-Weinberg assumption of infinitely large population size results in —

- (a) genetic drift
- (b) heterozygote advantage
- (c) consanguinity
- (d) genetic lethal.

2. Answer **any five** questions from the following :

2×5=10

(A) State the functions of RecA and RuvA.

(B) Calculate the 'generation time' and number of 'generations' in an exponentially growing population of bacterial cells with 9×10^6 cells/ml, which follow a 2 hour initial lag, and is allowed to grow.

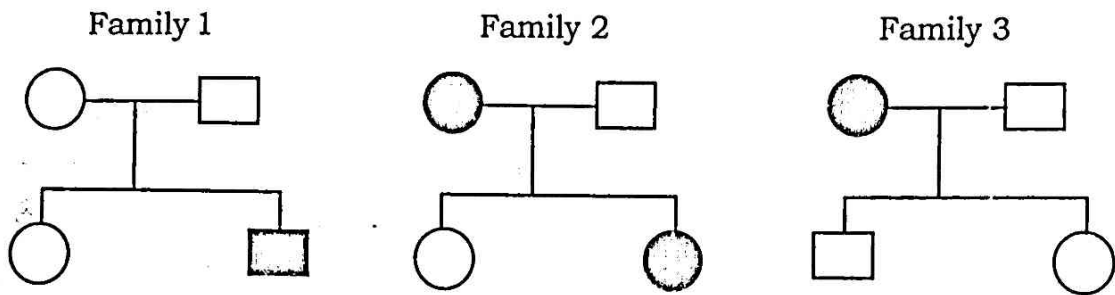
(C) What is the relationship between the formation of IP_3 and an elevation of intracellular Ca^{2+} ?

(D) What are retrotransposons? Differentiate between LTR and Non-LTR.

(E) Discuss the pattern of Diauxic growth in a microbial population subjected to two different carbohydrate sources.

(F) Discuss the role of Calmodulin with respect to Ca^{2+} binding in signaling pathway.

(G) The inheritance of a given disorder is recorded in three small families shown below. Based on the information, which *one* of the following patterns best explains the observation?



- (a) X-linked recessive
- (b) X-linked dominant
- (c) Autosomal recessive
- (d) Autosomal dominant

3. Answer *any five* questions :

2×5=10

(A) Describe the events that occur upon ligand binding to receptor tyrosine kinase.

(B) If the map distance between genes A and B is 15 map units and the map distance between genes B and C is 40 map units, what is the map distance between genes A and C?

(C) What is the role of G-protein in signaling pathway?

(D) Describe the mechanism of formation of the second messenger IP_3 .

(E) Describe some of the properties that distinguishes covalent and non-covalent bonds.

(F) Genes X, Y and Z are all located on one chromosome. Draw a simple map showing the gene order and relative distances among the genes X, Y and Z using the following data :

Crossover frequency	Between the genes
36%	X - Z
10%	Y - Z
26%	X - Y

(G) Distinguish between pluripotent stem cell and totipotent stem cells with examples.

4. Answer **any four** from the following questions : 2×4=8

Match each item of **Column-A** with the one in **Column-B** to which it is closely associated. Each item of **Column-B** can be used **only once**.

(A)	Column-A		Column-B
(a)	Pedigree analysis	(i)	Frequency of crossing-over
(b)	Centromere mapping	(ii)	Linkage
(c)	Recombination mapping	(iii)	Colour blindness
(d)	Tetrad analysis	(iv)	Linked loci
(e)	Haemophilia	(v)	Ordered tetrads in neurospora

Codes :

	(a)	(b)	(c)	(d)	(e)
1	iii	iv	ii	v	i
2	iv	iii	i	v	ii
3	iv	v	i	ii	iii
4	iii	ii	iv	v	i
5	i	ii	v	iv	iii

(B)	Column-A	Column-B
(a)	Frequency of recombination	(i) Crossing-over
(b)	Map distance	(ii) Diplotenè
(c)	Chiasmata	(iii) Linkage intensity
(d)	Genetic distance	(iv) Chromosome rearrangements
(e)	Gene mapping	(v) centi Morgan

Codes :

	(a)	(b)	(c)	(d)	(e)
1	iii	v	ii	i	iv
2	i	v	iii	iv	ii
3	ii	iv	v	iii	i
4	iii	iv	ii	i	v
5	i	iii	v	ii	iv

(C)	Column-A	Column-B
(a)	Peptide hormones	(i) Erythropoietin
(b)	Neuropeptide	(ii) Prostaglandin
(c)	Growth factors	(iii) Ecdysone
(d)	Eicosanoids	(iv) Glucagon
(e)	Steroid hormone	(v) Enkephalin

Codes :

	(a)	(b)	(c)	(d)	(e)
1	v	ii	iii	iv	i
2	i	v	ii	iv	iii
3	ii	iii	i	v	iv
4	iv	v	ii	i	iii
5	iv	v	i	ii	iii

- (D)
- Column-A**
- (a) Protein kinase C
 - (b) Cyclic GMP
 - (c) G Protein
 - (d) Cyclic AMP
 - (e) CaM kinase

- Column-B**
- (i) Protein kinase A
 - (ii) Hydrolysis of PIP_2
 - (iii) Calmodulin
 - (iv) Transducin
 - (v) Rhodopsin

Codes :

	(a)	(b)	(c)	(d)	(e)
1	iii	ii	i	iv	v
2	ii	iv	i	v	iii
3	ii	v	iv	i	iii
4	ii	iv	v	i	iii
5	iii	ii	i	v	iv

- (E)
- Column-A**
- (a) Regulation of enzyme activity
 - (b) Hydrophobic interactions
 - (c) DNA molecule
 - (d) Coenzymes
 - (e) Recombinant DNA

- Column-B**
- (i) Hydrogen bond
 - (ii) Prosthetic groups
 - (iii) Restriction endonuclease
 - (iv) Non-polar hydrophobic molecules
 - (v) Feedback inhibition

Codes :

	(a)	(b)	(c)	(d)	(e)
1	iii	ii	i	iv	v
2	v	iv	i	ii	iii
3	i	iii	ii	v	iv
4	iv	iii	ii	i	v
5	v	iii	ii	i	iv

5. Answer **any four** from the following questions :

3×4=12

(A) Genes A and B are 20 cM apart, An a^+b^+/a^+b^+ individual was mated with an ab/ab individual.

- (a) Diagram the cross and show the gametes produced by each parent and the genotype of the F_1 .
- (b) What gametes can the F_1 produce and in what proportion (in percentage) ?
- (c) If the F_1 was crossed to ab/ab individuals, what offspring would be expected, and in what proportion ? 1+1+1=3

(B) *Drosophila* females homozygous for three recessive X-linked markers, Y (yellow body), ct. (Cut wings) and m (miniature wings) and their wild-type alleles were crossed to Y, ct, m, males. The following progeny were obtained :

Phenotypic class	Number
1. Yellow, cut, miniature	30
2. Wild type	33
3. Yellow	10
4. Cut, miniature	12
5. miniature	8
6. Yellow, cut	5
7. Yellow miniature	1
8. Cut	1
	Total = 100

- (a) Which classes are parental types ?
- (b) Which classes represent double crossover ?

(c) What are the genotype of the heterozygous females used in the cross? 1+1+1=3

(C) In *Drosophila*, Bar eye (B) is a dominant mutation, while miniature wing (m) and yellow body colour (y) are recessive mutations. Heterozygous females from these mutations were crossed with normal eyed miniature winged and yellow body coloured males.

Assume the following progeny was obtained.

3

Phenotypes	Number	Phenotypes	Number
$B^+m^+y^+$	30	Bmy	20
B^+my^+	25	B^+my	185
Bm^+y^+	165	Bm^+y	110
B^+my^+	120	B^+m^+y	45

Based on the results obtained, the order of genes will be —

P. Bmy

Q. mBy

The genetic distance between B and y will be

R. 40 cM

S. 17.1 cM

The correct combination of answer is :

(a) P and R

(b) Q and R

(c) P and S

(d) Q and S

Contd.

(D) Three somatic hybrid cell lines, designated as X, Y and Z have been searched for the presence or absence of chromosome 1 through 8, as well as for their ability to produce the hypothetical gene product A, B, C and D as shown in the following Table :

Hybrid Cell Lines	Human Chromosomes present								Gene products expressed			
	1	2	3	4	5	6	7	8	A	B	C	D
X	+	+	+	+					-	+	-	+
Y	+	+			+	+			+	-	-	+
Z	+		+		+		+		+	+	-	+

Which of the following options has most appropriately assigned chromosomes for each of the given gene? 3

- (a) Gene A on chromosome 5, Gene B on chromosome 3, Gene C on chromosome 8 and gene D on chromosome 1.
- (b) Gene A on chromosome 5, Gene B on chromosome 3 only.
- (c) Gene D on chromosome 8, Gene C on chromosome 1, Gene B on chromosome 5 and Gene A on chromosome 4.
- (d) Gene A on chromosome 5, Gene B on chromosome 3 and Gene D on chromosome 1.

(E) A scientist is studying two traits in a type of beetle, body texture and colour. Smooth body (B) is dominant to bumpy body (b) and grey (G) colour is dominant to white (g).

A BbGg & bbgg beetle mate and produce the following offspring :

Phenotype	Number of offspring
Smooth, grey	345
Bumpy, white	355
Smooth, white	148
Bumpy, grey	152

What is the per cent recombination frequency for this cross? 3

(F) By means of the interrupted mating technique, five different Hfr strains (A, B, C, D, E) were analysed for the sequence in which they are transferred 10 different genes — (0, 1, 2, 3, 4, 5, 6, 7, 8 and 9) to an F-recipient. Each strain was found to transmit its genes in a unique sequence. The results of the experiment are presented in the following table (only the first six genes transferred are recorded).

Hfr strain					
	A	B	C	D	E
First	5	0	6	3	5
Second	7	2	7	4	8
Third	6	1	5	6	9
Fourth	4	8	8	7	0
Fifth	3	4	9	5	2
Sixth	1	6	0	8	1

What is the gene order in the original strain from which these 5 strains were derived? 3

SPACE FOR ROUGH WORK (IF REQUIRED)

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