M.Sc. 1st Semester Examination, 2019

ZOOLOGY

PAPER – ZOO-104(Gr.-A + B)

Full Marks : 40

Time : 2 hours

Answer **all** questions

The figures in the right hand margin indicate marks

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

Illustrate the answers wherever necessary

Write the answers to questions of each Group in separate books wherever necessary

GROUP – A

(*Cell Biology*)

1. Answer any *two* of the following : 2 × 2

   (*a*) What are the structural differences between three types of lipid molecules found in biomembrane ? 2

(*b*) Microtubule has polarity. What is the basis for this polarity ? 2

(*c*) Draw a schematic diagram showing DNA damage induced cell cycle arrest at different phases of cell cycle. 2

(*d*) Mention the name of TM and loops in a typical GPCR having more (*i*) hydrophobicity (*ii*) disulphide linkage. 1 + 1

2. Answer any *two* questions from the following : 4 × 2

(*a*) CdK1 mutation at 15th residue where tyrosine is replaced by phenyl alanine shows premature entry into mitosis. Explain the phenomenon with proper illustrations. 4

(*b*) GRB2 lacks intrinsic enzymatic activity, it is an essential component of the epidermar growth factor (EGF) signaling pathway that activates MAP kinase. What is the function of GRB2 ? What roles do the SH2 and SH3 domains play in the function of GRB2 ? 2 + 2

(*c*) The membrane potential in animal cells depends largely on resting K^+ channels. Why are these channel considered to be nongated channel ? How do K^+ channels achieve selectivity for K^+ versus Na^+, which is smaller than K^+ ? 1 + 3

(*d*) Explain how CDK activity is controlled or modulated by the following proteins : 4

(*i*) Cyclin
(*ii*) CAK
(*iii*) Wee 1
(*iv*) APC

3. Answer any *one* of the following : 8 × 1

(*a*) (*i*) One missense mutation at p54 subunit of SRP receptor over ER membrane leads to loss of GTP binding ability. A growing polypeptide chain attached with fluorophore binds with SRP. Where do you find that fluorescence tagged protein. Justify your answer.

(*ii*) State the role of CIP and INK4 family proteins in cell cycle regulation. 6 + 2

(*b*) (*i*) Resting Ca^{2+ER} is ~ 400 μM and $Ca^{2+cytosol}$ is ~ 100 nm. Sudden stimulus over plasmamembrane leads to increase in $Ca^{2+cytosol}$ to about 1 μM. Explain the mechanism of behind the increase in $Ca^{2+cytosol}$.

(*ii*) Describe the structure responsible for determining microtubule formation. 5 + 3

GROUP–B

(*CytoGenetics*)

4. Answer any *two* questions from the following : 2 × 2

(*a*) A population has eight times as many as heterozygotes as homozygous recessive. What is the frequency of the recessive allele ?

(*b*) What phenotypes might you expect in cells where

(*i*) pRB was phosphorylated constitutively.

(*ii*) a truncated pRB protein was produced that could not be phosphorylated.

(*c*) A cross is made between Hfr met^+ thi^+ pur^+ and F$^-$ met^- thi^- pur^-. Interrupted mating studies show that met^+ enters last, and are selected.

met^+ thi^+ pur^+	280
met^+ thi^+ pur^-	0
met^+ thi^- pur^+	6
met^+ thi^- pur^-	52

What is the gene order ?

(*d*) In a Landon population of cat, males and females for the yellow genotypes are scored

	Number		
	+/+	*+/y*	*y/y*
Females	277	54	7
Males	311		42

What are the gene frequencies in this population ?

5. Answer any *two* questions from the following : 4×2

(*a*) In an analysis of other r II mutants, complementation testing yielded the following :

Mutants	Result
1, 2	+
1,3	+
1, 4	–
1,5	–

Predict results of testing 2 and 3, 2 and 4 and 3 and 4 together and what do you conclude about mutant 5.

(*b*) The data in the following table obtained from a three point transduction test. A gene encode tryptophan synthetape, *anth* is linked as unselated marker. What is the linear order of anth and three mutant alleles of A gene in the table

Cross	Donor markers	Recipient markers	anth allele in Recombinant	% $anth^+$
1	$anth^+$–A34	$anth^-$ – A223	72 $anth^+$: 332 $anth^-$	18
2	$anth^+$–A46	$anth^-$ – A223	196 $anth^+$: 180 $anth^-$	52
3	$anth^+$–A223	$anth^-$ – A34	380 $anth^+$: 379 $anth^-$	50
4	$anth^+$–A223	$anth^-$ – A46	60 $anth^+$: 280 $anth^-$	20

(*Continued*)

(*c*) During cell cycle, p 16 protein is an inhibitor of cyclin/CDK activity. Predict the phenotype of cells homozygous for a loss of function mutation in the p^{16} gene that encode p^{16} protein would this gene be classified as a protooncogene or a tumor suppressor gene ?

(*d*) A cross is made between two *E. coli* strains : Hfr arg^+ bio^+ leu^+ X F^- arg^- bio^- leu^-. Interrupted mating studies shows that arg^+ enters the recipient last, and so arg^+ recombinants are selected on a medium containing bio and leu only. These recombinants are tested for the presence of bio^+ and leu^+. The following numbers of individuals are found for each genotype :

arg^+ bio^+ leu^+ – 320 arg^+ bio^- leu^+ – 0

arg^+ bio^+ leu^- – 8 arg^+ bio^- leu^- – 48

What is the gene order in the above *E.Coli* strain ?

6. Answer any *one* question from the following : 8×1

(*a*) The following are the observed ABO blood group phenotype among a group of 192 individuals from Wales.

A–63, B–31, AB–6, O–92

(*i*) Calculate the corrected estimates of the A, B and O gene frequencies.

(*ii*) How well does the observed distribution of phenotype agree with those expected on the basis of the calculated gene frequencies.

(*b*) (*i*) Suppose that a cell is heterozygous for a mutation that caused p53 to bind tightly and constitutively to DNA of its target genes. How would this mutation affect the cell cycle ? Would such a cell be expected to be more or less sensitive to the effects of ionizing radiation ?

(*ii*) In a phage a set of deletions is intercrossed in pair wise combinations.

The following results are obtained (with a + indicating wild type recombinant are obtained and – indicating no recombinant obtained)

	1	2	3	4	5
1	–	+	–	+	–
2	+	–	+	+	–
3	–	+	–	–	–
4	+	+	–	–	+
5	–	–	–	+	–

Construct a deletion map from this table. If this was a complementation map instead of a deletion map, how many discrete complementation regions would be indicated ?