M.Sc 1st Semester Examination, 2010

ZOOLOGY

PAPER—ZOO-104

Full Marks : 40

Time : 2 hours

The figures in the right-hand margin indicate marks

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

Write the answers to questions of each Group in separate books

GROUP—A

(*Immunology*)

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

(*a*) Why large granular lymphocytes are called Natural Killer cells ?

(*b*) What is antigen processing ?

(*c*) What is titer ?

(*d*) Write the steps of B-cell maturation.

2. Answer any *two* of the following : 4 x 2

(*a*) Describe the structure and biological function of IgE. 3 + 1

(*b*) Define primary and secondary lymphoid organs with examples. Describe the structural organization of any secondary lymphoid organ. 2 + 2

(*c*) Define adjuvant. State its mode of function. 1 + 3

(*d*) On which chromosomes of man and mouse MHC are located ? Give a general organization of MHC in humans. 1 + 3

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

(*a*) (*i*) Write the principle of Immuno-histochemistry. Describe briefly the steps and biological application of Immuno-histochemistry.

(*ii*) Give an account of two important factors regulating immuno genicity. (1 + 3 + 2) + 2

(*b*) Describe the method of Western blotting and its application. 6 + 2

GROUP – B

(*Cytogenetics*)

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

(*a*) A cross is made between *Hfr met*$^+$ *thi*$^+$ *pur*$^+$ ⊗ *F*$^-$ *met*$^-$ *thi*$^-$ *pur*$^-$. Interrupted mating studies. Show that met$^+$ enters last, so met$^+$ exconjugants are selected on medium containing thi and pur.

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

what is the gene order ?

(*b*) Mention the role of GTPase activating protein in cancelling cell cycle stimulatory signal.

(*c*) What is transducing retrovirus ? Give example.

(*d*) Phage integrates into a specific site on the host chromosome – is it generalized/ specialized transduction ?

2. Answer any *two* : 4 x 2

(*a*) All *pur* allele in defective enzyme *P* and map at one genetic locus 'A'. Complementation test among six mutant *pur* strains produces the following results (where a plus indicate complementation).

	1	2	3	4	5	6
1	–	–	–	–	+	–
2	–	–	–	–	+	+
3	–	–	–	–	–	–
4	–	–	–	–	–	+
5	+	+	–	–	–	+
6	–	+	–	+	+	–

(*i*) Draw a complementation map.

(*ii*) What kind of mutant 3 be ? $3\frac{1}{2}+\frac{1}{2}$

(*b*) The *rb* gene encodes a protein that inhibits *E2F*, a *transcription factor* that activates genes involved in cell division. Mutations in *rb* are associated with certain forms of cancer, such as *retinoblastoma.* Under each of the following conditions, would you expect cancer to occur ? 4

(*i*) One copy of *rb* is defective, both copies of *E2F* are normal.

(*ii*) Both copies of *rb* are defective, both copies in *E2F* are normal.

(*iii*) Both copies of *rb* are defective, one copy of *E2F* is defective.

(*iv*) Both copies of *rb* and *E2F* are defective.

(*c*) A p^{53} knock out mice (i.e. both copies of p^{53} are defective) has been produced by researchers. This type of mouse appear normal at birth. However it is highly sensitive to UV light. Based on your knowledge of p^{53}, explain the normal appearence of mice at birth and high sensitivity to *UV* light. 4

(*d*) In a population in Bengal, in coastal area, the frequencies of A, B, AB and O blood are as follows :

$$A = 0{\cdot}40$$
$$B = 0{\cdot}45$$
$$O = 0{\cdot}05$$
$$\text{and } AB = 0{\cdot}10$$

Calculate the allele frequencies of the A, B and O alleles in the population by assuming p for A, q for B and r for O. 4

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

(*a*) In a phage, a set of deletions is intercrossed in pairwise combinations. The following results are obtained (with a plus indicating that wild-type recombinants are obtained from that cross) :

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

(*i*) Construct a deletion map from this table.

(*ii*) If this was a complementation map instead of a deletion map, how many discrete complementation region would be indicated ?

(*b*) Three alleles are found at a locus coding for *malate dehydrogenase* (*MDH*) in the spotted chorus frog. Chorus frogs are collected from a breeding pool and each frog's genotype at the *MDH* locus were determined with electrophoresis. The following numbers of genotypes were found :

$M^1 M^1$	8
$M^1 M^2$	35
$M^2 M^2$	20
$M^1 M^3$	53
$M^2 M^3$	76
$M^3 M^3$	62
Total	254

(*i*) Calculate the frequencies of the M^1, M^2 and M^3 alleles in this population.

(*ii*) Predict whether the *MDH* genotypes in this population are in Hardy-Weinberg equilibrium.
