THE OPEN UNIVERSITY OF SRI LANKA

B.Sc. DEGREE PROGRAMME – LEVEL 04

FINAL EXAMINATION – 2009/2010

BOTANY

BTU 2102/BTE 4102/BTI 4102 – GENETICS, EVOLUTION & INTRODUCTORY MOLECULAR BIOLOGY

DURATION : TWO and HALF (21/2) HOURS

DATE : 2nd January 2010 TIME : 1.00 – 3.30 p.m.

ANSWER **FOUR (04)** QUESTIONS SELECTING AT LEAST **ONE (01)** FROM EACH PART

PART A

1.

A) Distinguish between

i) chromosomes and chromatids.

ii) sister and nonsister chromatids.

iii) homologous and nonhomologous chromosomes.

B) How are Mendel's rules of segregation and independent assortment related to mitosis and meiosis?

C) A hypothetical organism has six chromosomes (2n = 6).
How many different combinations of maternal and paternal chromosomes can appear in the gametes ?

2.

A)

i) Distinguish between coupling phase and repulsion phase in gene linkage.

ii) Explain why backcrosses involving parents, with genes linked in the coupling and repulsion phases, do not yield the same proportions of progeny phenotypes.

B) In an experiment with *Drosophila melanogaster*, females with cut wings (*ct*), vermilion eyes (*v*) and forked bristles (*f*) were mated to wild type males. The F_1 females were then backcrossed to *ct v f* males and 1000 progeny were scored :

Phenotype	No. of Progeny	Phenotype	No. of Progeny
+ + +	341	ct v +	96
ct v f	329	+ + f	104
ct + +	47	ct + f	16
+ v f	53	+ v +	14

i) Determine whether the loci are linked.

ii) If the genes are linked, determine the gene order.

i) Diagram the cross and determine the distances between the genes.

3.

A) Explain the following very briefly with examples

(a) Dominance
(b) Partial (incomplete) dominance
(c) Co-dominance

B) In cats, females homozygous for the dominant *B* allele are black and *bb* homozygous are orange. When black and orange cats are mated, the female progeny are always 'tortoise-shell' and their coats show a mottling of small black and orange patches, while the male progeny have the same coat colour as their mother. Only very rarely are male tortoise-shell cats found.

i) How do you explain these results ?
ii) What progeny are expected if tortoise-shell females are mated with black males ?

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PART B

4.

A) Nucleic acids isolated from four different species had the following base ratios (%) :

Species	A	T	U	G	C	$\frac{A+T \text{ (or } A+U)}{G+C}$	$\frac{A+G}{C+T \text{ (or } C+U)}$
1	17	17		33	33	0.5	1.0
2	29	19		22	30	0.97	1.0
3	24		16	24	36	0.66	1.0
4		34				2.1	1.0

For each species state whether,

(i) the nucleic acid is DNA or RNA

(ii) it is single-stranded or double-stranded

B) DNA of the bacteriophage T_2 contains 2×10^5 base pairs. (The molecular weight of T_2 is 1.3×10^8). How many genes of average size (encoding proteins of about 40,000 molecular weight) can this phage contain ?

Assume : The average molecular weight of an amino acid is 100.

C) Phage MS2 contains a molecule of single-stranded RNA which acts both as the phage chromosome and as messenger. The following is the coding sequence at the start of the coat protein gene and the corresponding amino acid sequence at the N-terminus of the coat protein :

Codon	1	2	3	4	5	6	7	8	9	10
Nucleotide	AUG	GCU	UCU	AAC	UUU	ACU	CAG	UUC	GUU	CUC ...
Amino acid		Ala	Ser	Asn	Phe	Thr	Gln	Phe	Val	Leu ...

What would be the effects on the amino acid composition of the coat protein if, as a result of mutation,

i) an A is deleted from within codon 4,

ii) the C is deleted from codon 4,

iii) the U in codon 6 is replaced by a G,

iv) the A in codon 6 is replaced by a G ?

5. Describe the reproductive isolation mechanisms that act as barriers between gene pools.

6. Write short notes on any <u>three</u> of the following.

a. Hardy-Weinberg Law
b. Different plate boundaries
c. Cro-Magnon man
d. Darwin's finches