



THE OPEN UNIVERSITY OF SRI LANKA

B.Sc. DEGREE PROGRAMME – LEVEL 04

FINAL EXAMINATION – 2005/2006

BOTANY

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

DURATION : TWO and HALF (2 1/2) HOURS

DATE : 28.10. 2006

TIME : 9.30 a.m. to 12.00 p.m.

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

PART A

1.

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 F₁ 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.
- iii) Diagram the cross and determine the distances between the genes.

2.

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 ?

3.

A)

- i) What are the differences between chromosomes and chromatids ?
- ii) What is the difference between sister and nonsister chromatids ?
What is the difference between homologous and nonhomologous chromosomes ?

B) What are the relationships between mitosis and meiosis and Mendel's rules of segregation and independent assortment ?

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

PART B

4.

A)

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

Species	A	T	U	G	C	$\frac{A + T \text{ (or } A + U\text{)}}{G + C}$	$\frac{A + G}{C + T \text{ (or } C + U\text{)}}$
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	1.5
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) The molecular weight of the *E. coli* chromosome is about 2.5×10^9 daltons. The average weight of a nucleotide is 330 daltons and the distance between two adjacent nucleotide pairs is 0.34 nm. The DNA double helix makes one complete turn every 3.4 nm.

(i) How long is the molecule ?

(ii) How many turns does the DNA contain ?

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. Discuss adaptive radiation with reference to Darwin's finches.

6. Write short notes on any **three (3)** of the following:

- A) Hardy-Weinberg Law
- B) Trends in primate evolution
- C) Plate tectonic theory
- D) Industrial melanism