



THE OPEN UNIVERSITY OF SRI LANKA

B.Sc. DEGREE PROGRAMME – LEVEL 04

FINAL EXAMINATION – 2011/2012

BOTANY

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

DURATION : TWO (02) HOURS

DATE : 29th December 2011

TIME : 9.30 – 11.30 a.m.

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

PART A

1.

- A) Explain briefly why three-point test crosses are useful in learning about the nature of gene linkage.
- B) Three recessive genes in linkage group V of the tomato are; *a* causing absence of anthocyanin pigment, *hl* producing hairless plants, and *j* producing jointless fruit stems (pedicels). Among 3000 progeny from a trihybrid testcross, the following phenotypes were observed:
- | | |
|------------------------|--|
| 259 hairless | 268 anthocyaninless, jointless, hairless |
| 40 jointless, hairless | 941 anthocyaninless, hairless |
| 931 jointless | 32 anthocyaninless |
| 260 normal | 269 anthocyaninless, jointless |
- i) How were the genes originally linked in the trihybrid parent?
- ii) Estimate the distance between the genes.

2.

- A) In a plant species, curled leaves (C) are dominant to elongated leaves (c). Round pollen (R) are dominant to irregular pollen (r). The progeny resulting from a cross between a plant bearing curled leaves, round pollen with that of curled leaves and irregular pollen is given below.

Plants with		No. of plants
curled leaves, round pollen		108
curled leaves, irregular pollen		102
elongated leaves, round pollen		31
elongated leaves, irregular pollen		34

- i) Explain these results.
- B) A pair of co-dominant alleles is known to govern cotyledon leaf colour in soybeans. The homozygous genotype $C^G C^G$ produces dark green, the heterozygous genotype $C^G C^Y$ produces light green, and the other homozygous genotype produces yellow leaves so deficient in chloroplasts that seedlings do not grow to maturity.

- i) If dark green plants are pollinated only by light green plants, what genotypic and phenotypic ratios would be expected in the mature progeny plants ?

3.

- A) What is epistasis ?
- B) Briefly explain the different types of epistasis observed (for 2-gene interactions?).
- C) Red colour in wheat kernels is produced by the genotype $R-B-$, white by the double recessive genotype ($rrbb$). The genotypes $R-bb$ and $rrB-$ produce brown kernels. A homozygous red variety is crossed to a white variety.
- i) What phenotypic results are expected in the F_1 and F_2 ?
- ii) If the brown F_2 is artificially crossed at random, what phenotypic and genotypic proportions are expected in the offspring ?

PART B

4.

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

B) DNAs of the bacteriophage T₂ contains 2×10^5 base pairs. (The molecular weight of T₂ 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.

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

- (a) Continental drift
- (b) The Miller - Urey Experiment
- (c) Cambrian period
- (d) *Homo erectus*

6. (i) Briefly explain the agents that can change the gene frequencies in a population.

(ii) A population study carried out 20 years ago in a separated grassland area indicated that the colour of the shell of the single snail population inhabiting it was normally distributed and it had extremely higher number of individuals with greenish shells compared to brownish or yellowish individuals. A recent survey carried out in the same area showed that the snail population had considerably higher numbers of brownish and yellowish individuals and the number of greenish individuals was very low. During the period between the two studies, the area had been subjected to erosion and brownish rocky areas and sandy patches were more common in the area and grasses were confined to few small patches.

Explain the type of evolution that this snail population had been experienced.

- Copyrights Reserved -