THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. DEGREE PROGRAMME – LEVEL 04
FINAL EXAMINATION – 2004/2005
BOTANY



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

DURATION: TWO and HALF (21/2) HOURS	
DATE: 03.06.06	TIME: 10.00 a.m. to 12.30 p.m.

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

# PART A

1.

- A) What are gene interactions? Briefly explain.
- B) The white leghorn breed of chickens is known to carry in homozygous conditions a colour allele (C) and a domonant inhibitor (I) that prevents the action of C. The white wyandotte (iicc) has neither the inhibitor nor the colour gene.
  - i) Give the F<sub>2</sub> phenotypes and properties expected from crossing a white leghorn (*IICC*) with a white wyandotte (*iicc*).
  - ii) Explain the type of interaction involved.

- A) Why were three-point crosses a valuable approach to learning about the nature of the linkage of genes?
- B) In Drosophila, kidney-shaped eye (k), cardinal eye (cd), and ebony body (e) are three recessive genes. If homozygous kidney, cardinal females are crossed with homozygous ebony males, the  $F_1$  offspring are all wild-type. If heterozygous  $F_1$  females are mated with kidney, cardinal, ebony males, the following 2,000 progeny appear:

880	kidney, cardinal	49.	kidney
887	ebony	46	ebony, cardinal
64	kidney, ebony	3	kidney, ebony, cardinal
67	cardinal	. 4	wild-type

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- i) Determine the chromosomal composition of the F<sub>1</sub> females.
- ii) Calculate the map distance between the linked genes and the gene order.
- C) Briefly explain the major aspects of genetic mapping.

3.

- A) Compare and contrast a X linked recessive trait, X linked dominant trait and a Y linked trait.
- B) A female fly with orange eyes is crossed with a male fly with short wings. The  $F_1$  females have wild-type (red) eyes and long wings: the  $F_1$  males have orange eyes and long wings. The  $F_1$  flies are crossed to yield the following progeny,

47 long wings, red eyes

45 long wings, orange eyes

17 short wings, red eyes

14 short wings, orange eyes

With no differences between sexes, What is the genetic basis of each trait? Explain.

C) If following were the sex chromosomes of *Drosaphila* flies, what would their sexes be? Justify your answer.

(Assume that the number of autosomal chromosome (A) sets are two)

xo	XY	XXY
XX	XXX	

### PART B

- 4
- A) What would be the effect of a mutation in the initiating codon of an mRNA?
- B) With the help of Table 1 and the following genetic code,
  - 5' AUGAGAUACCAUGGGCUAAUGUGAAAA 3'
  - i) predict,
    - a) the amino acid sequence of the small polypeptide encoded in this prokaryotic mini-message.
  - ii) What amino acid sequences would result if the following changes occurred in the message?
    - a) the first C is changed to a G.
    - b) the first U is changed to a G.
    - c) the first C is changed to a U
    - d) the second G is changed to an A.
    - e) the first C is deleted.
    - f) an extra G is added after the first G.

#### TABLE 1

### Second position

	U	Ć	Α	G	<b>6 6 9 9</b>
First position (5'-end)	UUU } Phe	ucu)	UAU } Tyr	ugu } Cys	
	บบดไ	UCC UCA UCG	UAC)	ugc) '	
	UUA }		UAA) STOP	UGA STOP	
	UUG } Leu		UAG	UGG Trp	
	ουυ	ccu	CAU	cgu	
	cuc (	ccc (	CAC His	CGC	end)
	CUA Leu	CCA Pro	CAA	CGA	(3,
	cug	cco	CAG GIn	cga	position (3'-end
	AUU )	ACU	AAU	AGU Ser	
	AUC } lie	ACC Thr	AAC	AGC Ser	Third
	AUA	ACA	AAA ]	AGA Arg	
	AUG Met	ACG	AAG Lys	AGG AT	
	່ເອບບ ໄ	GCU	GAU: Asp	agu )	
	GUC Val	GCC	GACL	GGC Gly	
	GUA	GCA	GAA Glu	GGA	
	GUG)	gcg)	.GAG	ggg)	

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	uuc J	UCC UCA UCG	UAC	ugc	
	UUA }		UAA STOP	UGA STOP	
	UUG ∫ Leu		UAG	UGG Trp	
	cuu	cou	CAU His	cgu	
	cuc (	ccc (	CAC	cgc \	3 '-end'
	CUA Leu	CCA Pro	CAA	CGA	
	CUG	cco	CAG Gin	cgg	position
	AUU )	ACU )	AAU }	AGU Ser	sod I
	AUC. } lie	ACC \ Thr	AAC	AGC J	Third
	AUA )	ACA	AAA ]	AGA Arg	
	AUG Met	ACG)	AAG Lys	AGG A''	
	'GUU	GCU)	GAU Asp	agu )	
	GUC Val	GCC Ala	GAC	GGC Giy	
	GUA	GCA	GAAI	GGA	
	GUG	.gcg)	GAG	agg )	

The genetic code. All sixty-four codons are listed, along with the amino acid for which each codes.

C) DNAs of the bacteriophage  $T_2$  contains  $2 \times 10^5$  base pairs. (The molecular weight of  $T_2$  is  $1.3 \times 10^8$ ). 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. Explain how the reproductive isolating mechanisms prevent the gene flow between species.
- 6. Write short notes on any two of the following.
  - a) The major ways by which natural selection acts on a trait (character) that varies in a population.
  - b) Continental drift.
  - c) Mammalian fauna of the Australian region.
  - d) Characteristics that distinguish man from apes.

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