



(Knowledge for Development)

**KIBABII UNIVERSITY
UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR**

**FOURTH YEAR SECOND SEMESTER
MAIN EXAMINATIONS**

FOR THE DEGREE OF BACHELOR OF SCIENCE IN BIOLOGY

COURSE CODE: SBL 421

COURSE TITLE: MOLECULAR BIOLOGY

DATE: Friday 6th November, 2020. TIME: 2:00 -4:00 p.m.

INSTRUCTIONS TO CANDIDATES

Answer Question one (1) and any other two (2) Questions.

Question one is compulsory and carries 30 marks, the other Questions carry 20 marks each.

TIME: 2 Hours

This paper consists of 4 printed pages. Please Turn Over 

KIBU observes ZERO tolerance to examination cheating

Question One

- a. Differentiate between transversion and transition as used in genetics. (4 marks).
- b. Compare and contrast Deoxyribonucleic acid (DNA) and Ribonucleic acid (RNA) (5 marks).
- c. State the Hardy-Weinberg equilibrium law (2marks).
- d. The DNA sequence of a gene from three independently isolated mutants is given below.

Mutant 1: ACCGTAATCGACTGGTAAACTTTGCGCG

Mutant 2: ACCGTAGTCGACCGGTAAACTTTGCGCG

Mutant 3: ACCGTAGTCGACTGGTAAACTTTGCGCG

Using this information, what is the sequence of the wild type gene in this region? (5 marks).

- e. Arrange the following statements in the appropriate order for determining whether a specific allele is present in a person's DNA (5 marks).
 - i. Amplify the DNA using PCR
 - ii. Label the probe DNA
 - iii. Isolate the sample DNA from an individual
 - iv. Hybridize with the relevant probe
 - v. Divide the DNA sample from an individual into two
- f. Differentiate between eukaryotic genome and prokaryotic genome (4 marks).
- g. What is the difference in extra-nuclear DNA and nuclear DNA? Give examples where applicable. (5 marks).

Question Two

The sequence of a complete eukaryotic gene encoding the small protein Met Tyr Arg Gly Ala is shown below. All of the written sequences on the template strand are transcribed into RNA.

5'-CCCCTATGCCCCCTGGGGGAGGATCAAAACACTTACCTGTACATGGC-3'
3'-GGGGATACGGGGGGACCCCTCCTAGTTTTGTGAATGGACATGTACCC-5'

- Which strand is the template strand? Which direction (right to left or vice versa) does RNA polymerase move along the template as it transcribes this gene? (4 marks).
- What is the sequence of the nucleotides in the processed mRNA molecule for this gene? Indicate the 5' and 3' directions of this gene (8 marks).
- A single base mutation in the gene results in the synthesis of the peptide Met Tyr Thr. What is the sequence of the nucleotides making up the mRNA produced by this mutant gene? (8 marks).

Question Three

A geneticist examined the amino acid sequence of a particular protein in a variety of mutants in E.coli. The amino acid in position 40 in the normal enzyme is glycine. The table below shows the substitutions the geneticist found at amino acid position 40 in five mutant forms of the enzyme.

Mutant	Amino acid
Mutant 1	Cysteine
Mutant 2	Valine
Mutant 3	Serine
Mutant 4	Aspartic acid
Mutant 5	Alanine

Using the genetic code below, determine the nature of the base substitutions that must have occurred in the DNA in each case (20 marks).

		SECOND (OR MIDDLE) BASE OF CODON					
		U	C	A	G		
FIRST BASE OF CODON (5' end)	U	UUU } Phe UUC } UUA } Leu UUG }	UCU } UCC } Ser UCA } UCG }	UAU } Tyr UAC } UAA } stop ochre UAG } stop amber	UGU } Cys UGC } UGA } stop opal UGG } Trp	U C A G	
	C	CUU } CUC } Leu CUA } CUG }	CCU } CCC } Pro CCA } CCG }	CAU } His CAC } CAA } Gln CAG }	CGU } CGC } Arg CGA } CGG }	U C A G	
	A	AUU } AUC } Ile AUA } AUG* } Met/ start	ACU } ACC } Thr ACA } ACG }	AAU } Asn AAC } AAA } Lys AAG }	AGU } Ser AGC } AGA } Arg AGG }	U C A G	
	G	GUU } GUC } Val GUA } GUG* } start	GCU } GCC } Ala GCA } GCG }	GAU } Asp GAC } GAA } Glu GAG }	GGU } GGC } Gly GGA } GGG }	U C A G	
						THIRD BASE OF CODON (3' end)	

Question Four

Polymerase chain reaction (PCR) is a vital molecular biology technique in the amplification of particular sections of a DNA sequence.

- What are the requirements for the PCR technique to take place? (5mks).
- Discuss the various stages in the PCR technique. (15mks).

Question Five

Discuss using a particular biological sample, the following aspects giving the vital principles within them. Use labelled diagrams to explain your answers where need be.

- DNA extraction (10 marks).
- Agarose gel electrophoresis (10 marks).