



**KENYATTA UNIVERSITY**  
**UNIVERSITY EXAMINATIONS 2011/2012**  
**SECOND SEMESTER EXAMINATION FOR THE DEGREE OF MASTER OF SCIENCE IN**  
**MEDICAL BIOCHEMISTRY**  
**SBC 546: BIOINFORMATICS**

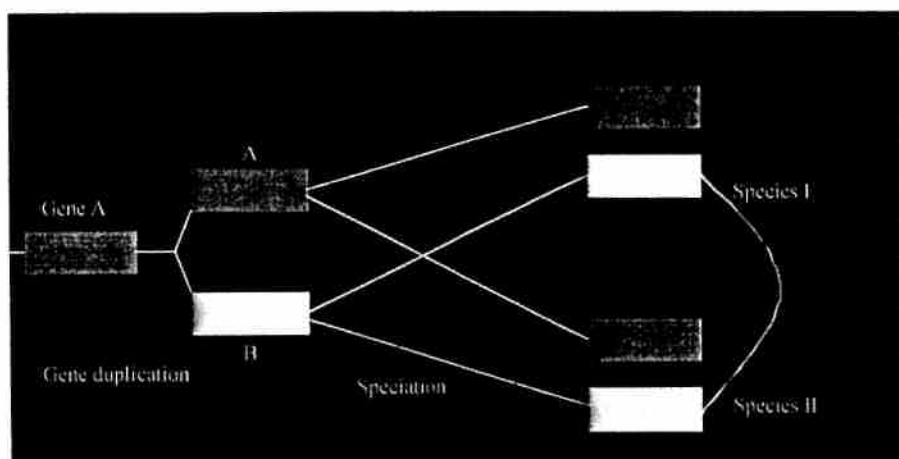
**DATE:** WEDNESDAY, 28<sup>TH</sup> MARCH, 2012

**TIME:** 2.00 P.M. – 5.00 P.M.

**INSTRUCTIONS**

**Section A: Answer all questions (5 Marks each)**

1. Refer to the diagram below, to answer the following questions.



- a) Species A and species B [2 mark].
- b) Species I and species II [3 marks].
2. Define the following terms
- a) Homology domain [4 marks].
- b) Homeomorphic domain [1 mark].
3. Calculate the melting temperature ( $T_m$ ) of the following PCR primer pairs.
- Forward Primer: CCA TCC CTT CCT CCA AAT AGA T  
Reverse Primer: CTT CCA CAC CCT AGT TTA GTG ACA A
4. What kind of topological signals do you know and where in general are they located?  
[5 marks]

5. Describe the process of protein secretion in prokaryotes and eukaryotes. [5 marks]
6. What is meant with (what are) C-scores, Y-scores, and S-scores? [5 marks]
7. Phosphorylation is a common form of protein post-translational modification. To understand its biological role, the site of phosphorylation has to be determined. How would you localize tyrosine phosphorylation in gel-separated proteins? [5 marks]
8. Describe the steps you would undertake to improve the sensitivity of your results while performing a similarity search with a short peptide mass fingerprint (PMF) or a short nucleotide sequence. [5 marks]

**Section B: Answer any 3 questions (20 Marks each)**

9. a) Describe the process of Polymerase Chain Reaction (PCR).  
b) What is the meaning of degenerate primers?
10. Explain in details the factors that affect the PCR?
11. a) In a database with a size of 100,000 amino acids, we find 100% alignment between the query sequence MVAETN and a database entry. What is the probability that this alignment occurs by chance using a PAM250 matrix? Motivate your answer. Use the table 1 and 2, below to answer this question. [10 Marks]

**Table 1. PAM250 matrix.**

|   | C  | S  | T  | P  | A  | G  | N  | D  | E  | Q  | H  | R  | K  | M | I | L | V | F | Y | W |   |
|---|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|
| C | 12 |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   | C |
| S | 0  | 2  |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   | S |
| T | -2 | 1  | 3  |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   | T |
| P | -3 | 1  | 0  | 6  |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   | P |
| A | -2 | 1  | 1  | 1  | 2  |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   | A |
| G | -3 | 1  | 0  | -1 | 1  | 3  |    |    |    |    |    |    |    |   |   |   |   |   |   |   | G |
| N | -4 | 1  | 0  | -1 | 0  | 0  | 2  |    |    |    |    |    |    |   |   |   |   |   |   |   | N |
| D | -5 | 0  | 0  | -1 | 0  | 1  | 2  | 4  |    |    |    |    |    |   |   |   |   |   |   |   | D |
| E | -5 | 0  | 0  | -1 | 0  | 0  | 1  | 3  | 4  |    |    |    |    |   |   |   |   |   |   |   | E |
| Q | -5 | -1 | -1 | 0  | 0  | -1 | 1  | 2  | 3  | 4  |    |    |    |   |   |   |   |   |   |   | Q |
| H | -3 | -1 | -1 | 0  | -1 | -2 | 2  | 1  | 1  | 3  | 6  |    |    |   |   |   |   |   |   |   | H |
| R | -4 | 0  | -1 | 0  | -2 | -3 | 0  | -1 | -1 | 1  | 2  | 6  |    |   |   |   |   |   |   |   | R |
| K | -5 | 0  | 0  | -1 | -1 | -2 | 1  | 0  | 0  | 1  | 0  | 3  | 5  |   |   |   |   |   |   |   | K |
| M | -5 | -2 | -1 | -2 | -1 | -3 | -2 | -3 | -2 | -1 | -2 | 0  | 0  | 6 |   |   |   |   |   |   | M |
| I | -2 | -1 | 0  | -2 | -1 | -3 | -2 | -2 | -2 | -2 | -2 | -2 | -2 | 2 | 5 |   |   |   |   |   | I |
| L | -6 | -3 | -2 | -3 | -2 | -4 | -3 | -4 | -3 | -2 | -2 | -1 | -3 | 4 | 2 | 6 |   |   |   |   | L |
| V | -2 | -1 | 0  | -1 | 0  | -1 | -2 | -2 | -2 | -2 | -2 | -2 | -2 | 2 | 4 | 2 | 4 |   |   |   | V |
| F |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   | F |
| Y |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   | Y |
| W |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   | W |
|   | C  | S  | T  | P  | A  | G  | N  | D  | E  | Q  | H  | R  | K  | M | I | L | V | F | Y | W |   |

- b) Compare the BLOSUM and PAM set of matrices. Which matrix should you use?  
[10 marks]
12. An amino acid sequence was determined of a ze m maize protein after extraction from 2D-gel using tandem mass spectrometry. The protein only showed up in the protein extract of maize leaves grown under UV light conditions. How can you annotate your protein sequence in the most proper way?