THE OPEN UNIVERSITY OF SRI LANKA

B.Sc. DEGREE PROGRAMME / STAND ALONE COURSE 2015/2016

LEVEL 5-FINAL EXAMINATION

CMU 3124/CME 5124
CHEMISTRY OF BIOMOLECULES

DURATION: 2 HOURS

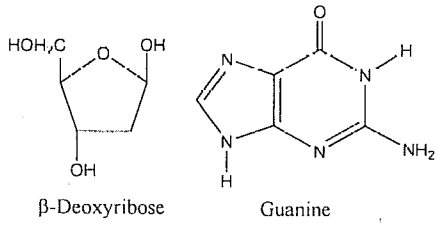
24th July 2016 1.00 p.m. - 3.00 p.m.

Answer any FOUR questions only.

If you have answered more than four questions, only the first four answers will be marked.

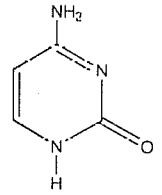
1. (a) (i) Describe the components of a nucleotide and explain what are nucleic acids?

(ii)Draw the structure of a dinucleotide in a nucleic acid containing guanine, cytosine and 2-deoxyribose.



β-Deoxyribose

Guanine



Cytosine

(50 marks)

(b) (i) Draw the H-bonding that could take place in the base pairing between guanine and cytosine.

(ii) Explain briefly the functions of DNA.

(30 marks)

(c) Write three important features of double helix structure of DNA.

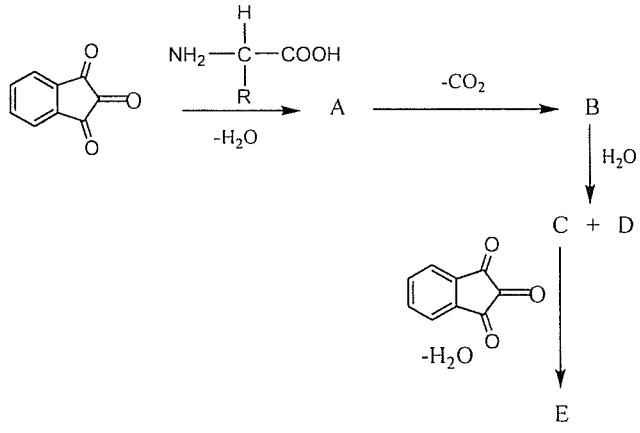
(20 marks)

2. (a) (i) Draw the structure of histidine at pH<1.82 and write an equation to show which proton is lost when the pH is raised above 1.82.

(ii) Explain why smaller molecules migrate faster in gel electrophoresis while larger molecules elute first in gel filtration.

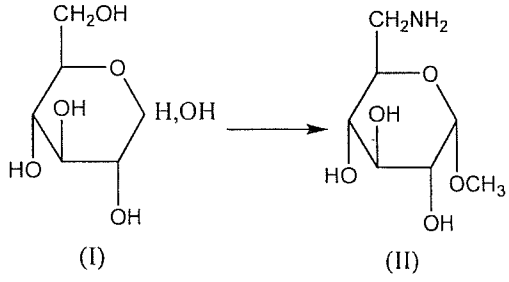
(30 marks)

b) Identify the products (A – E) of the following reaction scheme.



(40 marks)

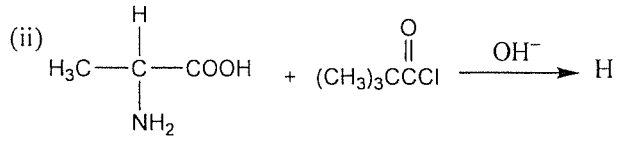
(c) How would you effect the following conversion?



(30 marks)

3.(a) Draw the structures of the products (F-I) you would expect in the following reactions.

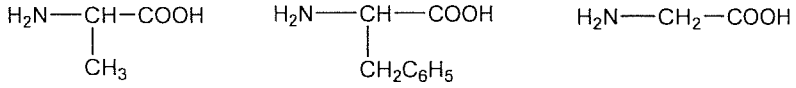
(i) $CH_3CHO + NH_3 + HCN \longrightarrow F \xrightarrow{H^+/H_2O} G$

(ii) 

(iii) $NH_2CHRCOOH + PhCH_2OH \xrightarrow{HCl} I$

(30 marks)

(b) (i) Phenylalanine and glycine are the N-terminal and C-terminal residues respectively of a tripeptide composed of phenylalanine, glycine and alanine. Write the structural formula for the tripeptide.

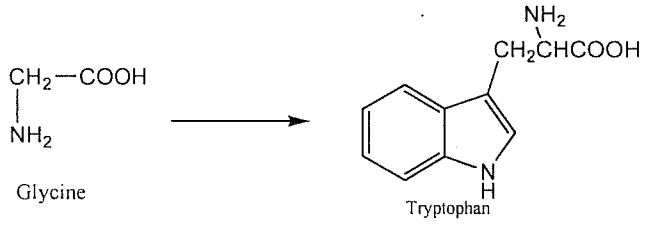


Alanine Phenylalanine Glycine

(ii) Give the structural formulae of the products obtained when the tripeptide is reacted with 2,4-dinitroflurobenzene followed by acid hydrolysis.

(40 marks)

(c) How would you effect the following transformation? Give the necessary reagents and write the mechanism for the reaction.



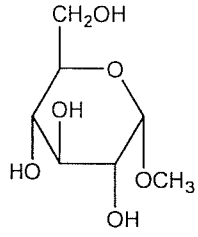
Glycine Tryptophan

(30 marks)

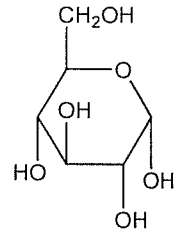
4. (a) Write down the Fischer projection formula of all the D-hexoses having the structural formula $OHC(CHOH)_4CH_2OH$. Which of these on oxidation with nitric acid give optically inactive dicarboxylic acids? Explain briefly your answer.

(25 marks)

(b) Describe one chemical test which may be used to distinguish between methyl α-D-glucopyranose (I) and α-D-glucopyranose (II).



(I)



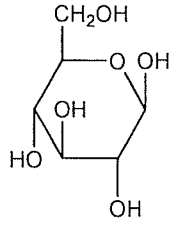
(II)

(15 Marks)

(c) Draw the structures of the major product when β-D-glucopyranose is treated with

(i) Excess $(CH_3CO)_2O$, pyridine, 120°C

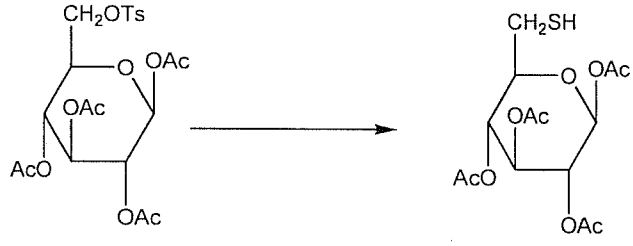
(ii) $CH_3COOH/AC_2O/HBr$



β-D-glucopyranose

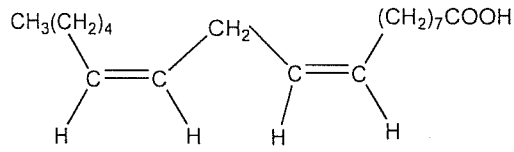
(30 marks)

(d) How would you effect the following conversion?



(30 marks)

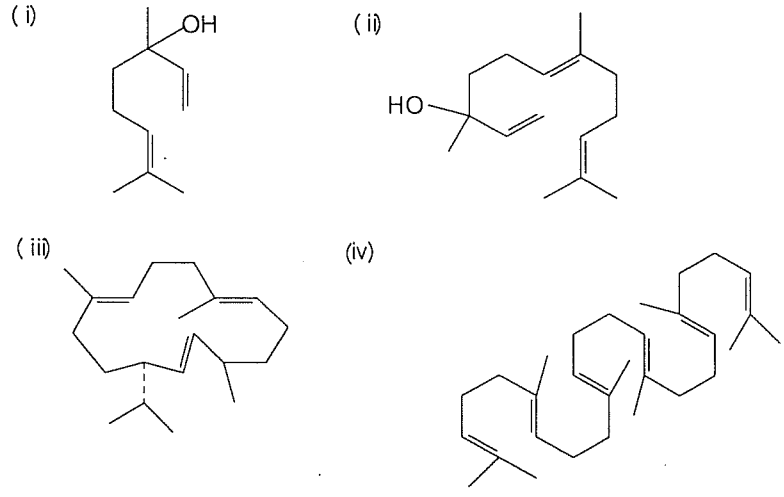
5. a) (i) Give the IUPAC name of the following structure.



(ii) Draw the structure of 18:1 (n-6) fatty acid. Give its IUPAC name.

(20 marks)

b) State the isoprene rule and dissect the following compounds into head-tail linkage and deduce the number of isoprene units in it.



(25 marks)

c) Write a brief account on five biologically active steroids.

(30 marks)

d) Indicate the biological functions of phospholipids.

(25 marks)

6. a) Classify the following reactions as catabolic/anabolic giving reasons.
   i. Formation of glycogen from glucose
   ii. Formation of pyruvate from glucose

(10 marks)

b) Free energy for hydrolysis of phosphoenolpyruvate and ATP at 25°C are -61.9 and -30.5 kJ mol^{-1}. Show that the reaction given below is spontaneous.

Phosphoenolpyruvate + ADP → pyruvate + ATP

(20 marks)

c) Distinguish between the following pairs.

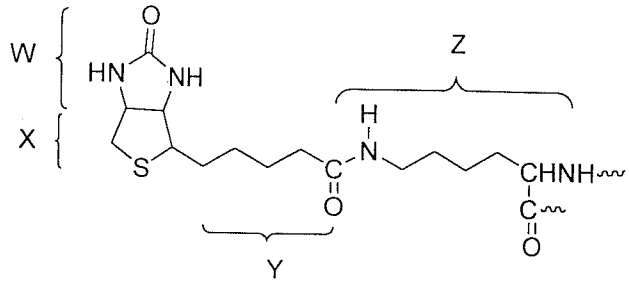
i. Coenzyme and prosthetic group

ii. Apoenzyme and holoenzyme

iii. Substrate and co-substrate

(30 marks)

d) Biocytin is the coenzyme involved in carboxylation reactions.

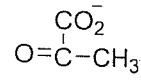


biocytin

i. Name the fragments labeled as W, X, Y and Z.

ii. Write the mechanism of reaction between CO_2 and biocytin.

iii. Show how carboxybiocytin transfers the carboxyl group to enol form of pyruvate.



pyruvate

(40 marks)