THE OPEN UNIVERSITY OF SRI LANKA

B.Sc. DEGREE PROGRAMME / STAND ALONE COURSE 2014/2015

LEVEL 5-FINAL EXAMINATION

CMU 3124/CME 5124
CHEMISTRY OF BIOMOLECULES

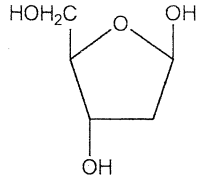
DURATION: 2 HOURS

Thursday 12th November 2015 9.30 a.m. - 11.30 a.m.

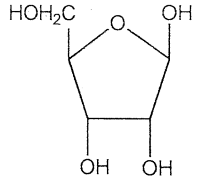
Answer any FOUR questions only.

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

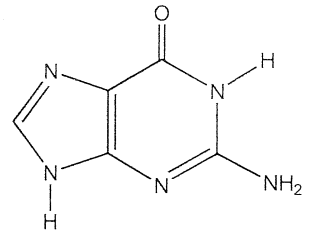
1. (a) (i) What are the components of the deoxyribonucleic acid (DNA)?
   (ii) How does ribonucleic acid (RNA) differ from DNA?
   (iii) What are nucleosides?
   (iv) Provide structures for the nucleosides deoxy Cytidine (dc) and Guanosine (G).



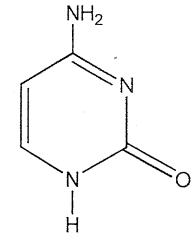
β-Deoxyribose



β-ribose



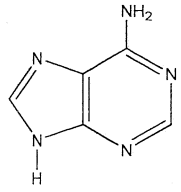
Guanine



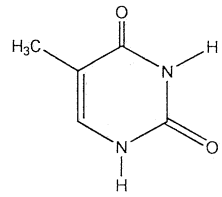
Cytosine

(50 marks)

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



Adenine



Thymine

(10 marks)

(ii) Explain briefly the function of RNA (m-RNA, t-RNA, r-RNA).

(20 marks)

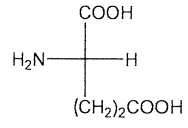
(c) (i) Give a general structural formula for the naturally occurring α-amino acids and indicate the importance.
(ii) Explain their classification as essential and non-essential amino acids.
(iii) Which amino acid is achiral?

(20 marks)

2. (a) (i) Define the isoelectric point.
(ii) In an electric field, towards which electrode would an amino acid migrate under the following conditions:
1. pH < pI
2. pH > pI and
3. pH = pI

Explain.

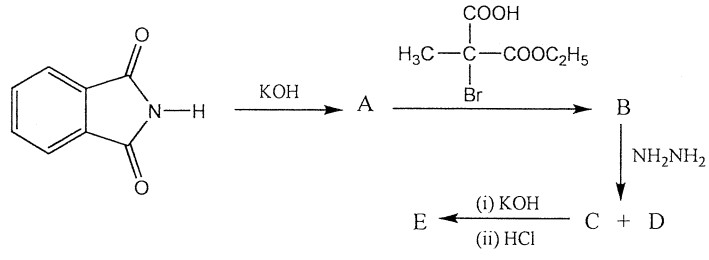
(iii) Draw the predominant form of glutamic acid at pH = 0, 3, 8.5, 12 given that pI = 3.22, pK_{a1} = 2.19, pK_{a2} = 9.67 and pK_{a3} (side chain) = 4.30.



glutamic acid

(30 marks)

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



(30 marks)

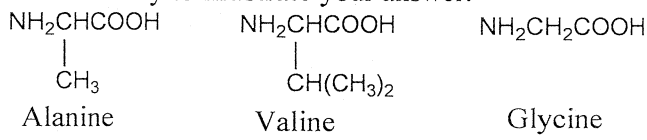
(c) Define primary, secondary, tertiary and quaternary structures of a protein.

(20 marks)

(d) Explain how a mixture of amino acids is separated by ion-exchange chromatography.

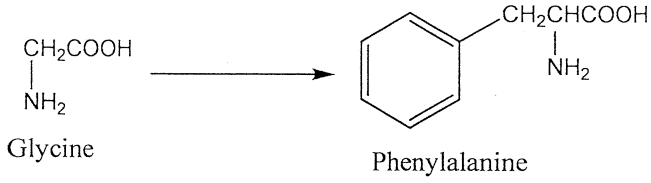
(20 marks)

3.(a) 2,4-Dinitroflurobenzene and phenylisothiocyanate are both used for N-terminal analysis of peptides. Write down the reactions involved in each method and explain the most important differences between them. Use the tripeptide Val.Ala.Gly to illustrate your answer.



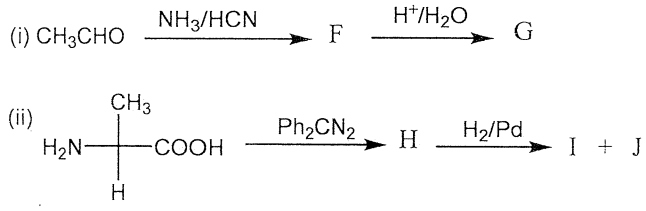
(40 marks)

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



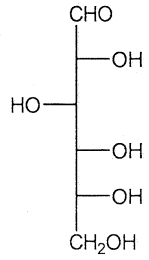
(30 marks)

(c) Identify the compounds F – J you would expect from the following reactions.

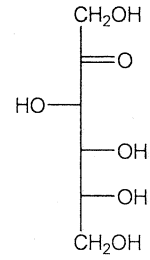


(30 marks)

4. a) (i) Draw the cyclic structures (Haworth projections) for D-glucose and D-fructose.



D-glucose

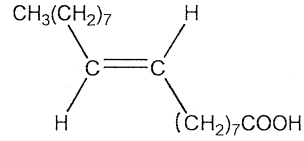


D-fructose

(ii) Draw the structure of sucrose formed from D-glucose and D-fructose.

(30 marks)

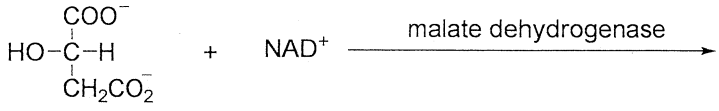
b) (i) Give the IUPAC name of the following structure.



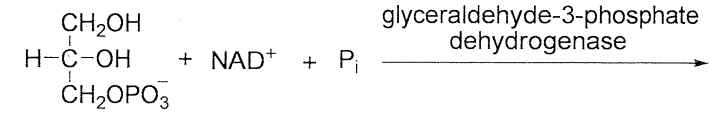
(ii) Draw the structure of 22:6 (n-3) fatty acid. Give its IUPAC name.

(20 marks)

c) Give the products of the following redox reactions.

i. 

L-malate

ii. 

glyceraldehyde-3-phosphate

(10 marks)

d) Free energy of hydrolysis of creatine phosphate and glycerol-3-phosphate are -43.1 and 9.7 kJ mol^{-1} respectively. Deduce whether the following reaction is spontaneous.

creatine phosphate + glycerol → creatine + glycerol-3-phosphate

(20 marks)

e) Explain the following in brief.

i. Eating large quantities of raw eggs is not favourable.

ii. Deficiency in Vitamin K causes delay in blood clotting.

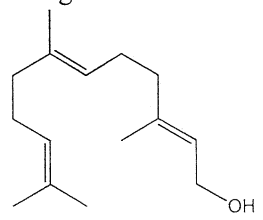
(20 marks)

5. a) Give the products that you could expect if the oleic acid $CH_3(CH_2)_7CH{=}CH(CH_2)_7COOH$ (cis) is partially hydrogenated.

(20 marks)

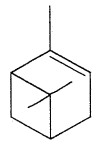
b) State the isoprene rule and dissect the following compounds into head-tail linkage and deduce the number of isoprene units in it.

(i)



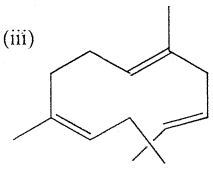
farnesol

(ii)



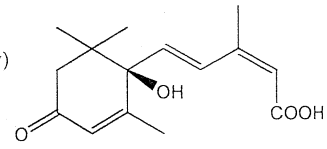
α-pinene

(iii)



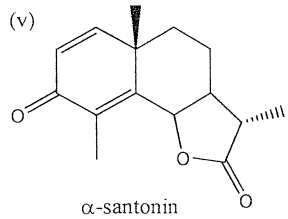
humulene

(iv)



abscisic acid

(v)



α-santonin

(30 marks)

c) List biological activities of the following.

(i) Bile acids
(ii) Adrenocortical hormones
(iii) Sex hormones

(30 marks)

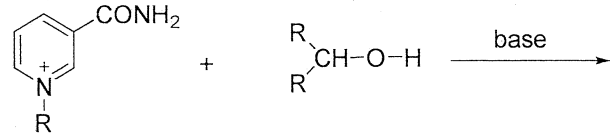
d) Indicate the functions of the cell membrane.

(20 marks)

6. a) Food consumed by chemotrophs is converted to ATP *via* acetyl CoA. Give the major steps involved in this pathway.

(20 marks)

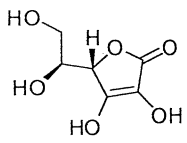
b) Show the products of the following reaction giving mechanism.



(20 marks)

c) Vitamin C is considered as a strong reducing agent.

i. Give the structure of its reduced form.
ii. What is the importance of vitamin C in the body as a reducing agent?



Vit. C

(20 marks)

d) Enzyme inhibitors have different mechanisms of action.

i. What is meant by noncompetitive inhibition?

ii. Give an example for noncompetitive inhibition.

iii. How can noncompetitive inhibition be overcome?

iv. How does noncompetitive inhibition differ from uncompetitive inhibition?

(40 marks)