THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. DEGREE PROGRAMME / STAND ALONE COURSE 2014/2015
LEVEL 5-FINAL EXAMINATION
CHU 3131/CHE 5131
THE CHEMISTRY OF SUGARS, AMINO ACIDS AND RELATED COMPOUNDS

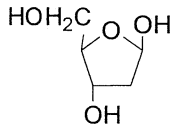
DURATION: 2 HOURS

Friday, 30th October 2015 9.30 a.m. - 11.30 a.m.

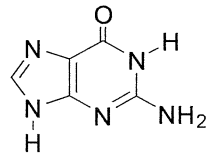
Answer any FOUR questions only.

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

1. (a) (i) What are nucleic acids?
   (ii) What are the components of the deoxyribonucleic acid (DNA)?
   (iii) How does ribonucleic acid (RNA) differ from DNA?
   (iv) Draw the structure of the nucleotide, formed from 2'-deoxyribose, guanine and phosphate.



2'-Deoxyribose

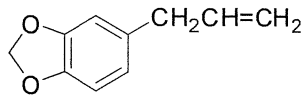


Guanine

(40 Marks)

(b) Phenolic compounds given below are derived from different biosynthetic pathways. Name the possible biosynthetic pathway for each of them.

(i)



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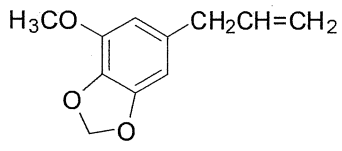

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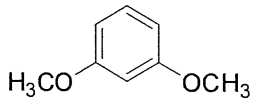

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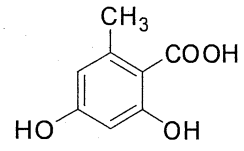
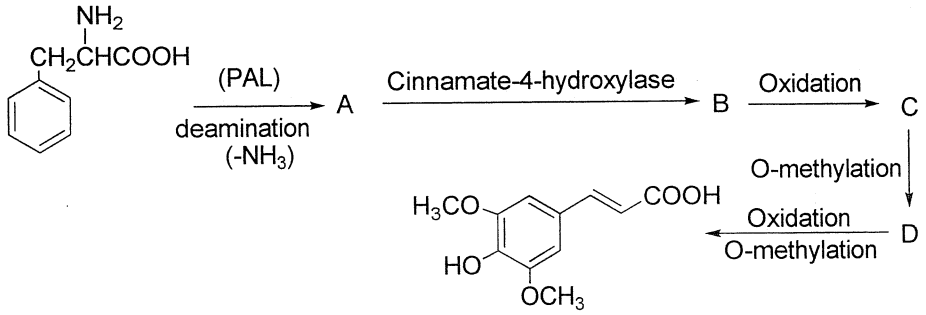


(20 Marks)

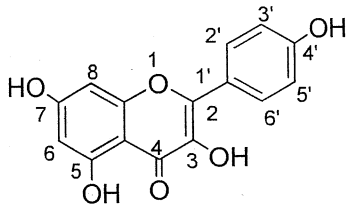
(c) Write the intermediates (A-D) in the biosynthesis of Sinapic acid from Phenylalanine, $PhCH_2CH(NH_2)COOH$.



Sinapic acid

(40 Marks)

2. (a) Kaempferol (E) is a flavonol. UV spectrum of kaempferol (E) in ethanol shows an absorption band in the region 250 - 270 nm.



Kaempferol (E)

(i) a) Indicate the shift observed in the UV spectrum of kaempferol (E) when $AlCl_3$ is added. Explain your observation.
b) Draw the structure of the complex that is responsible for the shift.

(ii) What change would you expect in the UV spectrum of (E) when alcoholic NaOAc is added? Explain your answer.

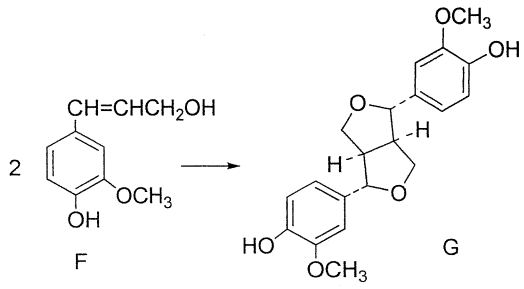
(iii) Indicate clearly the carbon atoms that contain hydrogen atoms which could show *ortho* and *meta* coupling in the H-NMR spectrum of Kaempferol (E).

(50 Marks)

(b) List five biological activities of flavonoids.

(20 Marks)

(c) Give the mechanism involved in the biosynthesis of compound G from F indicating the enzyme involved.



(30 Marks)

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

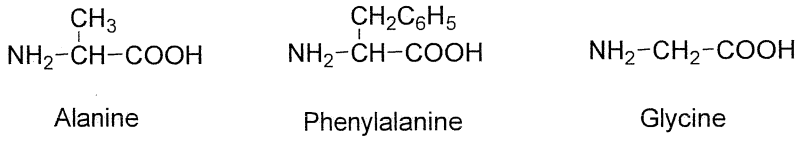
(i) $CH_3CHO + NH_3 + HCN \longrightarrow \mathbf{H} \xrightarrow{H^+/H_2O} \mathbf{I}$

(ii) $H_3C-\underset{\displaystyle NH_2}{\overset{\displaystyle H}{\underset{|}{\overset{|}{C}}}}-COOH + (CH_3)_3CC(=O)Cl \xrightarrow{OH^-} J$

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

(30 Marks)

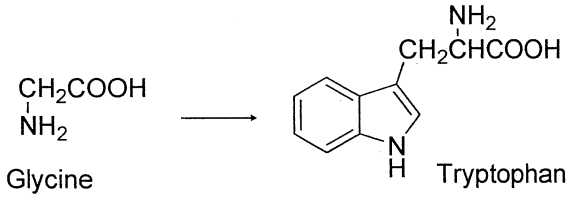
(b) (i) Phenylalanine and glycine are the N-terminal and C-terminal residues respectively of a tripeptide composed of phenylalanine, glycine and alanine. Write the structural formula for the tripeptide.



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

(40 Marks)

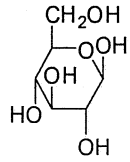
(c) How would you effect the following transformation? Give the necessary reagents and write the mechanism for the reaction.



(30 Marks)

4. a) Draw the structures of the major products when β-D-glucopyranose is treated with

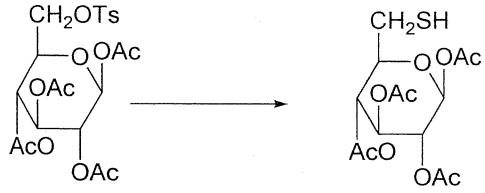
(i) CH_3COCl, dry $CH_3OH/80^oC$.
(ii) excess Ac_2O, pyridine, 120°C



β-D-glucopyranose

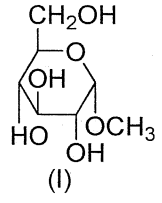
(30 Marks)

(b) How would you effect the following conversion?

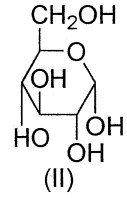


(30 Marks)

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



(I)



(II)

(15 Marks)

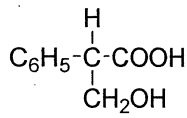
(d) Write down the Fischer projection formula of all the D-pentoses having the structural formula, $OHC(CHOH)_3CH_2OH$. Which of these on oxidation with nitric acid give optically inactive dicarboxylic acids? Explain briefly your answer.

(25 Marks)

5. (a) Outline, using a flow chart, how you would isolate the alkaloid fraction from a methanol extract of a plant.

(20 Marks)

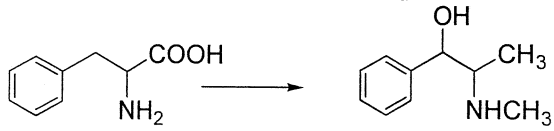
(b) Devise a simple synthesis of tropic acid starting from acetophenone ($C_6H_5COCH_3$).



Tropic acid

(40 Marks)

(c) Postulate the biosynthetic pathway leading to ephedrine from phenylalanine.



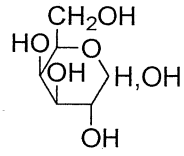
Phenylalanine Ephedrine

(40 Marks)

6. (a) (1) Deduce and give the structures of lactose, a disaccharide which is present in milk.

(i) It is hydrolysed by β-galactosidase to D-glucose and D-galactose.
(ii) It is a reducing sugar that mutarotates.
(iii) Its osazone is hydrolysed to D-galactose and D-glucosazone.
(iv) Methylation followed by hydrolysis of lactose gives 2,3,6-tri-O - methyl-D-glucose and 2,3,4,6-tetra-O-methyl-D-galactose.

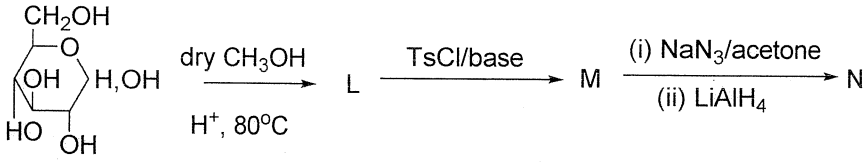
(2) Give the structural formula for the osazone of lactose.



D-galactose

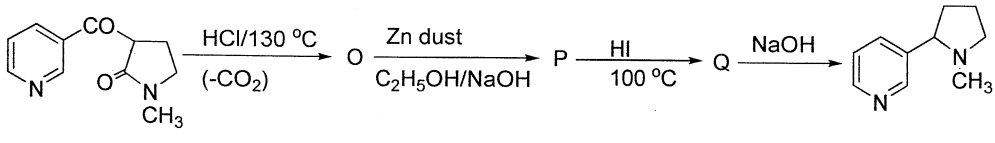
(40 Marks)

(b) Give the structures of compounds (L-N) in the following reaction scheme.



(30 Marks)

(c) Reactions involved in the synthesis of nicotine are given below. Identify the compounds O-Q in the reaction scheme.



(30 Marks)